United States Court of Appeals

for the

District of Columbia Circuit

TRANSCRIPT OF RECORD

FOR MR. JUSTICE BOBS

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United States Court of Appeals for the District of Columbia

APRIL TERM, 1935

756

No. 6523

Carlton 287

BAKELITE CORPORATION, APPELLANT,

vs.

CONWAY P. COE, COMMISSIONER OF PATENTS.

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA.

FILED JULY 27, 1935.

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United States Court of Appeals for the District of Columbia

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BAKELITE CORPORATION, APPELLANT,

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APPELLEE.

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA.

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United States Court of Appeals for the District of Columbia

a Supreme Court of the District of Columbia.

In Equity.

No. 56517.

Bakelite Corporation, Plaintiff,

vs.

Conway P. Coe, Commissioner of Patents, Defendant.

United States of America,
District of Columbia, ss:

Be it remembered, that in the Supreme Court of the District of Columbia, at the City of Washington, in said District, at the times hereinafter mentioned, the following papers were filed and proceedings had, in the above-entitled cause, to wit:

1 Filed December 5, 1933.

In the Supreme Court of the District of Columbia.

In Equity.

No. 56517.

Bakelite Corporation, Plaintiff,

vs.

Conway P. Coe, Commissioner of Patents, Defendant.

Bill of Complaint to Secure Issuance of Patent.

To the Honorable Judges of the Supreme Court for the District of Columbia:

The plaintiff, for its bill of complaint, under the provisions of section 4915 of the Revised Statutes of the United States, alleges:

(1) That the plaintiff, Bakelite Corporation, is a corporation organized and existing under and by virtue of the laws of the State of Delaware and has a regular place of business at 247 Park Avenue, New York, N. Y.

(2) That the defendant, Conway P. Coe, is the Commissioner of Patents of the United States, a legal resident of the District of Columbia, and is sued as Commissioner of Patents of the United States.

(3) That Lawrence V. Redman, a subject of Great Britain, residing at Caldwell, New Jersey, did invent certain new and useful improvements in Abrasive Implements, for which invention an application for Letters Patent of the United States was filed in the United States Patent Office on August 19, 1927, entitled "Abrasive Implement", which application was given the Serial Number 214219.

(4) That on August 17, 1927, the said Lawrence V. Redman, by a proper instrument in writing, did sell,
2 assign and transfer unto the said Bakelite Corporation, the plaintiff herein, the entire right, title and interest in and to the invention and application aforesaid, which instrument of assignment was duly recorded in Liber L 131, page 72 of the Patent Office Transfers of Patents, and that since plaintiff, Bakelite Corporation, acquired said right, title and interest in and to said invention and application, it has been and now is vested with all right, title and interest therein and thereunto. Profert of the said assignment is hereby made.

(5) That said application was filed in accordance with the Laws of the United States and with the Rules of the Patent Office.

(6) That said application has been duly prosecuted in accordance with the Laws of the United States and with the Rules of the Patent Office.

(7) That the invention involved in this proceeding is an abrasive implement comprising a flexible base to which abrasive grains are secured by means of a bond which is flexible at normal and higher temperatures and infusible at all temperatures and non-tacky under all conditions of use.

(8) That said application has been passed upon by the Primary Examiner, who allowed two of the claims but refused to allow the following claims:

A. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.

3 B. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer,

which claims he finally rejected in accordance with the Rules of the Patent Office.

(9) That from the decision of the Primary Examiner an appeal was taken to the Board of Appeals, who affirmed the rejection of the Primary Examiner in their decision dated June 5, 1933.

(10) That the plaintiff further states that the invention is new and useful, and was not known or used by others in this country before the invention thereof by said Lawrence V. Redman, and not patented or described in any printed publication in this or any foreign country before the invention thereof by said Lawrence V. Redman, or more than two years prior to his application for patent therefor, and not in public use or on sale in this country for more than two years prior to said application, and not patented in any foreign country by said Lawrence V. Redman or his legal representatives or assigns on an application filed more than twelve months prior to said application for United States Letters Patent, and not abandoned.

Wherefore the Plaintiff prays:

(1) That this Honorable Court adjudge that the said Plaintiff, Bakelite Corporation, is entitled according to law to receive Letters Patent of the United States for the aforesaid invention as described in the following terms:

As a new article of manufacture, an abrasive implement
comprising a flexible base or carrier, and abrasive grains
secured thereto by a bond which is flexible at normal
4 and higher temperatures but infusible at all temperatures, and non-tacky under all conditions of use.

(2) That this Honorable Court adjudge that the said plaintiff, Bakelite Corporation, is entitled according to law to receive Letters Patent of the United States for the aforesaid invention as defined in the aforesaid claims A and B.

(3) That this Honorable Court decree that the Commissioner of Patents be directed to allow the aforesaid claims A and B, and such other claims as upon hearing the Court may find patentable.

(4) That this Honorable Court decree that the Commissioner of Patents be directed to allow a claim of the following wording:

As a new article of manufacture, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a bond which is flexible at normal and higher temperatures but infusible at all temperatures, and non-tacky under all conditions of use.

(5) For such other and further relief in the premises as the nature of the case may require and as to this Honorable Court may seem meet.

BAKELITE CORPORATION,
By GEORGE BAEKELAND,
Vice President.

RICHARD L. SCHEFFLER,
Counsel for Plaintiff,
CHARLES H. POTTER,
RALPH E. PARKER,
JOS. N. NIELSEN,
Of Counsel.

5 STATE OF NEW YORK,
County of New York, ss:

George Baekeland, being duly sworn, deposes and says that he is Vice President of Bakelite Corporation, the Plaintiff named in the foregoing bill; that he has read the foregoing bill subscribed by him, and knows the contents thereof; that the same is true of his own knowledge except as to such matters as therein are stated to be on information and belief, and as to those matters he believes it to be true; and that the reason why this verification is not made by the Plaintiff is because it is a corporation.

GEORGE BAEKELAND.

Subscribed and sworn to before me this 4th day of December, 1933.

K. L. GRANT,
[SEAL] *Notary Public.*

Notary Public, New York County, No. 295.
New York Co. Register's No. 5-G-307.
Commission expires March 30, 1935.

Answer to Bill of Complaint.

Filed December 20, 1933

* * * * * * *

To the Honorable The Judges of the Supreme Court of the District of Columbia.

Conway P. Coe, Commissioner of Patents, defendant herein, in answer to the Bill of Complaint alleges on information and belief as follows:

1. He admits for the purpose of this suit the allegations of organization and principal place of business of plaintiff.

6 2. He admits the allegations of paragraph 2, except to state that defendant's legal residence is in the State of Maryland and his official residence as Commissioner of Patents is in the District of Columbia.

3. He admits that Lawrence V. Redman, on the 19th of August, 1927, filed an application in the United States Patent Office to which Serial No. 214,219 was given. Two of the claims of that application have been allowed by the examiner.

4. He admits the allegations of assignment.

5. He admits that the application was filed in accordance with the statutes and Rules.

6. He admits that the application was duly prosecuted.

7. He admits the allegation of paragraph 7 in so far as it is supported by the said application as originally filed.

8. He admits that the primary examiner passed upon the application and allowed two claims, but refused to allow claims A and B copied in paragraph 8 as said claims are

held to be unpatentable over the following prior patents, viz.:

Carlton, 1,775,631, Sept. 16, 1930, (filed March 13, 1926);
Byck, 1,590,079, June 22, 1926;
Redman, 1,591,999, July 13, 1926;
Low, 1,243,312, Oct. 16, 1917;
Martin, 1,626,246, April 26, 1927;
Crupi, 1,468,960, Sept. 25, 1923.

Profert of copies of these patents is hereby made, all of which are of record in the case.

9. He admits that appeal from the decision of the primary examiner was taken to the Board of Appeals and that the Board of Appeals in a decision rendered June 5, 1933, affirmed the decision of the primary examiner in refusing to allow the two claims.

7 10. He admits the allegations of paragraph 10 in so far as they relate to the subject matter of the two allowed claims.

Further answering defendant denies that the claims recited in the Bill are patentable as more fully appears from the Statement of the Examiner and the decision of the Board of Appeals, copies of which will be presented at the hearing.

Further answering defendant denies that the two claims recited in the prayer of the Bill are properly before the Court for consideration as they were rejected by the Examiner, cancelled by the attorney for applicant, and are not in the application as pending claims and it does not appear that they have ever been considered by the Board of Appeals.

And further answering defendant denies each and every allegation of the Bill of Complaint not herein specifically and sufficiently denied or admitted, and prays that plaintiff's Bill of Complaint be dismissed.

Wherefore defendant having fully answered the Bill of Complaint denies that plaintiff is entitled to the relief demanded or any part thereof and prays that the Bill be dismissed with all costs of the proceedings against the plaintiff as provided in Section 4915 R. S.

CONWAY P. COE,
Commissioner of Patents,
Defendant.

T. A. HOSTETLER,
Solicitor of the U. S. Patent Office,
Attorney for Defendant.

District of Columbia,
City of Washington, ss:

I, Conway P. Coe, Commissioner of Patents, depose and
say that I have read the above answer by me subscribed
and know the contents thereof, and that the state-
8 ments of facts therein made as upon personal knowl-
edge are true, and those made upon information and
belief I believe to be true.

CONWAY P. COE,
Commissioner of Patents.

Subscribed and sworn to before me this 19th day of December, 1933.

ALBERT W. KAISER,
[SEAL.] *Notary Public, D. C.*

My commission expires March 21, 1938.

Memorandum of Court.

Filed February 19, 1935.

* * * * * * *

The Examiner in the Patent Office and the Board of Appeals unanimously concluded that plaintiff is not entitled to patent covering claims set out in the bill. Consideration of the evidence offered at the hearing, the same in substance as that considered by the Patent Office, fails to lead the Court to a contrary conclusion.

The bill will be dismissed; decree to be settled on notice.

February 19th, 1935. JOSEPH W. COX,
Justice.

Findings of Fact

Filed March 20, 1935.

* * * * * * *

I. This is a suit brought under the provisions of Section 4915 of the Revised Statutes (35 U. S. Code Sect. 63) because of the refusal of the Commissioner of Patents to grant a patent to the plaintiff on the application of Lawrence V. Redman, for an improvement in Abrasive Implements, Serial No. 214,219, filed August 19, 1927, for
9 the invention specified in certain claims as recited
in the bill of complaint herein.

II. The plaintiff is the owner of the entire right, title and interest in and to said application, and the invention covered thereby, by virtue of assignment from the said Lawrence V. Redman, and is now the applicant.

III. The Commissioner of Patents has refused to grant the plaintiff a patent upon said application, for the invention as specified in said claims thereof, and this suit was brought within six months of such refusal.

IV. No appeal has been taken from the decision of the Board of Appeals refusing the patent to the United States Court of Customs and Patent Appeals, and no such appeal is pending or has been decided.

V. The Redman application, Serial No. 214,219, discloses as an allegedly novel article of manufacture a flexible abrasive sheet, of the nature of sand paper, composed of a flexible backing sheet to which abrasive grains are bonded by means of a resinous bonding material which is (a) inherently flexible at normal and elevated temperatures, (b) infusible at all temperatures, and (c) non-tacky under all conditions of use. The abrasive sheet is alleged to be strong, durable, and inert to moisture, common solvents and atmospheric conditions, as well as flexible and infusible.

VI. The Carlton patent, 1,775,631, discloses an abrasive article having a flexible base or backing, an abrasive material and a flexible binder comprising a synthetic resin such as Phenol-formaldehyde condensation products.

VII. The Low patent, 1,243,312, discloses a process of treating soft natural resin which comprises heating the same under pressure with formaldehyde vapors.

VIII. The Crupi patent, 1,468,960, discloses an abrasive sheet in which a flexible water-resisting cement is
10 utilized for holding abrasives on the backing.

IX. The Martin patent, 1,626,246, discloses an abrasive article in which the binding material comprises a synthetic resin such as a phenol resin.

Conclusions of Law.

1. The claims are unpatentable over the prior patents adduced by defendant.

2. The claims for which plaintiff contends are unpatentable over the Carlton patent, No. 1,775,631.

3. Plaintiff is not entitled to a decree under Section 4915 R. S. and the Bill of Complaint will be dismissed.

JOSEPH W. COX,
Justice of the Supreme Court
of the District of Columbia.

Final Decree.

Filed March 20, 1935.

* * * * * * *

This cause having come on to be heard and having been tried in open court and argued by counsel for the respective parties upon the pleadings and proofs adduced and submitted to the Court.

It is adjudged, ordered and decreed this 20th day of March, 1935, that the Bill of Complaint in this case be, and the same hereby is dismissed with costs against the plaintiff.

JOSEPH W. COX,
Justice.

From the foregoing decree the plaintiff, Bakelite Corporation, in open court on the date named above, notes an appeal to the United States Court of Appeals for the District of Columbia, and the Court fixes the cost bond on said
11 appeal in the sum of $100, or in lieu thereof the sum of $50 cash to be deposited with the Clerk of this Court.

JOSEPH W. COX,
Justice.

Memoranda.

April 10, 1935—Statement of Evidence signed, made of record and filed.

April 12, 1935—$50 deposit in lieu of Bond on Appeal.

Assignment of Errors.

Filed April 12, 1935

* * * * * * *

Now comes the plaintiff, in the above-entitled cause, and files the following assignment of errors upon which it will rely upon the prosecution of its appeal from the decree of this Honorable Court, entered on the 20th day of March, 1935:

I. The Court erred in dismissing the Bill of Complaint herein.

II. The Court erred in not entering a decree adjudging that the plaintiff is entitled, according to law, to receive Letters Patent on its application, Serial No. 214,219, filed August 19, 1927, as specified in the claims recited in the Bill of Complaint herein.

III. The Court erred, in matter of law, in concluding that the subject-matter of the claims of the aforesaid application recited in the Bill of Complaint herein is unpatentable over the prior patents, including U. S. Patent No. 1,775,631
12 to Carlton, adduced by defendant.

Wherefore, Plaintiff prays that the said decree may be revised and reversed.

POTTER, PIERCE & SCHEFFLER,
By RALPH E. PARKER,
Attorneys for Plaintiff.

Washington, D. C., April 12, 1935.

Stipulation and Designation of Record.

Filed April 30, 1935.

* * * * * * *

The Clerk will please prepare and transmit to the United States Court of Appeals for the District of Columbia, as the record in the above-entitled cause, the following papers, which, it is stipulated, shall constitute the printed record on appeal:

I. Bill of Complaint.
II. Answer to Bill of Complaint.
III. Condensed Statement of Evidence.
IV. Plaintiff's Exhibits as follows:

1. Certified copy of file wrapper and contents of Redman application Serial No. 214,219.

V. Defendant's Exhibits as follows:

(A) U. S. patent to Carlton, No. 1,775,631;
(B) U. S. patent to Low, No. 1,243, 312;
(C) U. S. patent to Crupin, No. 1,468,960;
(D) U. S. patent to Martin, No. 1,626,246;
VI. Court's Memorandum dated February 19, 1935.
VII. Findings of Fact and Conclusions of Law.
13 VIII. Final Decree, Notation of Appeal, and Order fixing amount of appeal bond.
IX. Docket Entry showing cash deposit in lieu of appeal bond.
X. Assignment of Errors.
XI. This Stipulation and Designation of Record.

It is hereby stipulated and agreed that the following exhibits shall be transmitted to, and be considered by, the United States Court of Appeals for the District of Columbia, as physical exhibits, to wit:

Plaintiff's Exhibits Numbers:

2. Sample of sandpaper made in accordance with the Carlton disclosure patent No. 1,775,631;

3. Sample of sandpaper made in accordance with the Carlton disclosure patent No. 1,775,631;

4. Sample of sandpaper made in accordance with the Redman disclosure Serial No. 214,219;

5. Sample of sandpaper made in accordance with the Redman disclosure Serial No. 214,219;

6. Sample of sandpaper made in accordance with the Carlton disclosure, patent No. 1,775,631, 2nd Example, resin made without plasticizer;

7. Sample of sandpaper made in accordance with the Carlton disclosure, patent No. 1,775,631, 2nd Example, resin made with plasticizer;

8. Sample of sandpaper made in accordance with Example 1 of Carlton patent No. 1,775,631, resin made without plasticizer;

14 9. Sample of sandpaper made in accordance with Example 1 of Carlton patent No. 1,775,631, resin made with plasticizer;

10. Sample of sandpaper made by a process which was a modification of the process of Example 2 of Carlton patent No. 1,775,631, resin made without plasticizer;

11. Sample of sandpaper made by a process which was a modification of the process of Example 2 of Carlton patent No. 1,775,631, resin made with plasticizer;

12. Sample of sandpaper made by a process which was a modification of the process of Example 1 of Carlton patent No. 1,775,631, resin made without plasticizer;

13. Sample of sandpaper made by a process which was a modification of the process of Example 1 of Carlton patent No. 1,775,631, resin made with plasticizer.

POTTER, PIERCE & SCHEFFLER,
Solicitors for Plaintiff.
T. A. HOSTETLER,
Solicitor for Defendant.

Washington, D. C., April 29, 1935.

15 Supreme Court of the District of Columbia.

United States of America,
District of Columbia, ss:

I, Frank E. Cunningham, Clerk of the Supreme Court of the District of Columbia, hereby certify the foregoing pages numbered from 1 to 14, both inclusive, to be a true and correct transcript of the record, according to directions of counsel herein filed, copy of which is made part of this transcript, in cause No. 56517 in Equity, wherein Bakelite Corporation is Plaintiff and Conway P. Coe, Commissioner of Patents, is Defendant, as the same remains upon the files and of record in said Court.

In testimony whereof, I hereunto subscribe my name and affix the seal of said Court, at the City of Washington, in said District, this 27th day of June, 1935.

[Seal Supreme Court of the District of Columbia.]

FRANK E. CUNNINGHAM,
Clerk.

16 In the Supreme Court of the District of Columbia,
Holding an Equity Court.

In Equity.

No. 56,517.

BAKELITE CORPORATION, Plaintiff,

vs.

CONWAY P. COE, Commissioner of Patents, Defendant.

Statement of Evidence.

Be it remembered that at the trial of this cause before Mr. Justice Joseph W. Cox on February 1 and 4, 1935, proceedings were had and evidence was taken as follows:

Evidence was introduced establishing facts as found by the Court in its Findings 1 to 9, inclusive.

Howard Leonard Bender was called as an expert witness on behalf of the plaintiff and, being duly sworn, qualified as an expert in the phenolic resin art and testified that he was acquainted with the Redman application Serial No. 214,219 for "Abrasive Implement" and personally carried out, under the direction of said applicant, experimental work on the production of flexible abrasive paper in which the bonding agent for the abrasive grains is characterized by flexibility combined with infusibility, thereby combining these properties in the abrasive paper; the flexibility is inherent in the bonding agent in the absence of added plasticizing agents. This work led to the filing of said Redman application.

Witness further testified that a phenol-aldehyde resin of the type invented by Dr. Baekeland normally is 17 produced by reacting a phenol with an aldehyde in the presence of a catalyst and thereafter heating the resulting liquid reaction product over a more or less protracted period, by which heating the initial reaction product is progressed through three successive stages of resinification, to wit, (1) by heating until water (or ammonia) is split off from the initial reaction product, to give a so-called "A Stage" wherein the resin is normally a fusible and soluble solid when cold but a liquid when hot, (2) continued heating of the "A Stage" resin producing the so-called "B Stage", jelly-like when hot and a solid brittle substance when cold, and finally (3) an infusible and insoluble brittle solid resin in the so-called "C Stage" or final stage of resinification. Phenol-aldehyde resins in the "A Stage" or "B Stage" will slowly convert to the "C Stage" at ordinary temperatures and that heating only accelerates this conversion. The resin finds its usefulness in the final or "C Stage"; it is only used in the "A Stage" for conversion into the "C Stage". Phenol-aldehyde resins of the sort known and used at the time the present invention was made were characterized by being brittle and rigid even in thin sheets and therefore not useful in the manufacture of an abrasive paper wherein flexibility was an essential feature.

Witness further testified that attempts had been made by prior investigators to modify the inherent brittleness and rigidity of normal phenol-aldehyde resins by adding to the resins substances known as "plasticizing agents"; these impart plasticity or softness, thereby reducing brittleness, but not flexibility.

18 Inquiries had failed to show that there was available on the market any sandpaper made in accordance with the Carlton patent, although the owners of that patent were large manufacturers of sandpapers.

By Mr. Nielsen:

"Q. You have stated that one of these samples, that is, the No. XK-2637 made according to the Carlton procedure, had castor oil present as a plasticizer. Will you define a plasticizer? A. A plasticizer is a substance added to a plastic like resin or cellulose products for the purpose of rendering it softer and more plastic, and is normally a liquid product which exists in solution or perhaps loosely held in the mass and having the effect of plasticizing the whole. It can normally be found as a separate chemical present in the mass."

* * * * * * *

"Q. You have indicated that attempts have been made in the past—that brittleness of the resin can be reduced by adding plasticizers. What is the nature of these plasticizers? What kind of plasticizing agents have been used?

A. The plasticizing is a difficult process because the infusible resin has very rightly been described many many times
as an insoluble substance. The plasticization has
19 been limited by this question of solubility. Various
products have been used, and each may be used up to
its point of solubility, with commercial—in certain commercial developments. The solubility limit, however, being low for the normal plasticizers, the effect of plasticizing is naturally low.

Q. Can you mention some of the agents that have been used? A. Castor oil, fatty oils in general, like tung oil, glycerine, dibutyl phthalate. Any number of materials have been mentioned in the past.

By the Court:

Q. Neat's foot oil is one of these types of things? A. Neat's foot oil is far less soluble, and possible of no use in our art on account of insolubility.

By Mr. Nielsen:

Q. To what extent can such agents be included to reduce brittleness? A. It differs with the different materials and, to a slight extent, with the use to which it is put, that is, to the hardness to which you are making the resin. Taking castor oil, we will find it soluble to the extent of about
30 per cent in the unhardened resin, which solubility
20 decreases as we heat-harden, until for commercial
uses the limit is practically 12 per cent by weight
on the resinous body. For glycerine the initial solubility is approximately 40 per cent, which decreases with heating and the hardness of the product until a workable limit of approximately 20 per cent may be obtained. However, with glycerine, which is slightly promising because of its percentage, the factor of water sensitivity enters in. The resin is definitely more sensitive to water with 20 per cent glycerine present than it is unplasticized.''

Witness further testified that addition to the resin of the maximum amount of plasticizing agent which it will retain modifies the resin to the extent that the so-modified resin is less easily broken by a sudden blow but that the plasticized resin is still brittle and shatterable when cold and not sufficiently flexible in thin sheet to withstand ordinary handling and bending; and that inclusion of plasticizers depreciates the adhesiveness of the resin.

By Mr. Nielsen:

"Q. Am I correct, then, Dr. Bender, in summarizing your testimony as to plasticizers, that they can not be included in sufficient amounts to impart the flexibility necessary for a flexible sandpaper; and, on the other hand, if they are included beyond these points, that the adhesive character, the cementing action, is destroyed? A. As regards infusible resin, you are correct."

21 Witness further testified that for the production of flexible abrasive paper applicant approached the problem in a radically new way by using as the bond for the abrasive grains a wholly new type of resin produced by reacting phenol with an unsaturated organic body, such as an unsaturated fatty oil, whereby there is formed a new phenolic compound from which neither phenol, as such, nor unsaturated organic body, as such, can be separated, and then reacting this new compound with aldehyde in substantially the theretofore known manner for reacting phenol with aldehyde for the production of a resin; that this new type of resin is inherently flexible in the final "C Stage" of resinification, in the absence of any added plasticizer, is not affected by water or mineral oils, is strong in the infusible state, and has all the adhesiveness or bonding quality of normal phenol-aldehyde resin; and that sandpaper manufacturers turned to the commercial manufacture of flexible, heat-resistant, fast cutting, non-gumming abrasive paper using as the bond therein applicant's new type of resin.

Witness further testified that on behalf of applicant, Lawrence V. Redman, he as an expert in the phenolic resin art had made repeated attempts to prepare flexible abrasive paper by precisely carrying out the processes disclosed in the Carlton patent No. 1,775,631, by using as the bond for the abrasive grains both normal phenol-aldehyde resin in an early stage of resinification and normal phenol-aldehyde resin to which one or another of a variety of plasticizers had been added, but that no commercially usable flexible abrasive paper could be produced from a bonding material obtained by either of the Carlton processes, the unplasticized resin bond being brittle and rigid and the

22 plasticized resin being non-adhesive and therefore not a usable bonding material; that these unsuccessful attempts to make a usable flexible abrasive paper were described in a certain affidavit executed by him on March 30, 1932, which affidavit is contained in the record of the Redman application and with which there were filed certain samples of sandpaper, referred to in said affidavit and here identified as plaintiff's Exhibits Nos. 2, 3, 4 and 5, Nos. 2 and 3 having been made by the Carlton process and Nos. 4 and 5 having been made by the Redman process; that as an expert in the art there had been, to his knowledge, no suggestion of a flexible resin bond in the sandpaper industry prior to the making of the Redman invention, and that as an expert in the art he could see no similarity between the Carlton bonding agent and the Redman bonding agent either as to their respective modes of preparation or as to their respective properties as bonds for abrasive grains.

Witness further testified that on behalf of applicant Redman he in 1934 made up further samples of resin in accordance with both of the processes described in the Carlton patent which resin samples were turned over to Mr. Robert Paul Courtney for the production of abrasive paper.

Upon cross-examination witness testified that the inherent flexibility in final infusible and insoluble state characterizing the resin bond of the Redman flexible abrasive paper is attributable to the fact that, in making the resin, aldehyde is reacted with a new phenolic body, made by first reacting phenol with an oil or other reactant, instead of with phenol itself.

23 **Robert Paul Courtney** was called as a witness on behalf of the plaintiff and, being duly sworn, testified that he had had large experience in the phenol-resin field and in the sandpaper field; that he obtained from Dr. Howard Leonard Bender samples of phenol-aldehyde resins prepared by the two processes described in the Carlton patent, which resin samples the witness applied to paper surfaces and to metal surfaces and baked under different conditions of time and temperature; that he found that unplasticized resins produced by the Carlton process were not susceptible to being spread out into smooth films but gathered into lumpy films and when heated as taught by

Carlton to the point where they were unaffected by water were brittle and unsuitable for flexible sandpaper, and that the resins when plasticized as taught by Carlton were brittle and inflexible.

By Mr. Nielsen:

"Q. What would you regard as a commercial usable sandpaper? A. Well, it must be a sandpaper—you mean a flexible sandpaper?

Q. A flexible sandpaper, yes. A. It must be sandpaper that can be bent sharply around a rubbing block or can be bent in a position that it can be held on the palm of the hand so that it can be used both on flat surfaces and in corners and over corners without cracking the bond and without loosening the abrasive particles so that they fall out; so that on being used for a reasonable length of time it will retain its sharpness and cutting qualities."

24 Witness further testified that he thereafter prepared resins in accordance with each of the processes of the Carlton patent disclosure and used them as bonding agents in abrasive paper tests, plaintiff's Exhibits Nos. 6, 7, 8 and 9, in which Nos. 6 and 7 were prepared according to Carlton's Example 2, No. 6 being without plasticizer while No. 7 contained 20% glycerin as plasticizer, and in which Nos. 8 and 9 were prepared according to Carlton's Example 1, No. 8 being without plasticizer while No. 9 contained 20% glycerin as plasticizer. When he strictly followed the process disclosed in Example 1 of the Carlton patent, using zinc chloride as a catalyst, the initial reaction mixture formed two layers, the upper of which was the resinous layer and the lower of which was a watery layer, whereas in the Carlton patent it was stated that the resinous matter was in the lower layer and the upper layer was watery; that from this discrepancy he could conclude only that Carlton had not actually performed his Example 1 because if he had he would have observed whether the resin was above the water or vice versa. Each of the test samples, plaintiff's Exhibits 6, 7, 8 and 9, was inflexible and brittle and therefore not useful as a flexible product.

Witness further testified that thereafter he attempted to make operative the process described by Carlton by considerably increasing the period of heating the phenol with

the aldehyde used by Carlton, and tested the resulting
25 resins for the preparation of abrasive papers (plaintiff's Exhibits Nos. 10, 11, 12 and 13): that abrasive paper samples Nos. 10, 11, 12 and 13 made up with the longer reacted resins as bonding agents for the abrasive grains showed an improvement over the abrasive paper samples, plaintiff's Exhibits Nos. 6, 7, 8 and 9, but were valueless as flexible sandpaper because of their rigidity and brittleness, and moreover showed the defect of insufficient penetration into the backing sheet; and that he had been unable to produce commercially usable flexible abrasive papers by any process disclosed or suggested by Carlton.

When the Court examined the samples constituting plaintiff's Exhibits 10, 11, 12 and 13, the witness explained that the standard test for flexibility of abrasive paper involved bending the paper over the third and fourth fingers, with the grain surface on the outside, whereupon the following observations were made:

"The Court: These will not stand much bending (demonstrating with samples).

The Witness: I should say that none of them would stand very much.

The Court: It does not seem to be quite readily bent back."

Upon cross-examination witness gave the following testimony:

By Mr. Miller:

26 "Q. Mr. Courtney, you testified as to having studied the disclosure of the Carlton patent and being familiar with it. In your opinion does this patent or does it not disclose an abrasive device which comprises a flexible base, abrasive grains, and a binder for securing the grains to the base? A. If I understood your question right the answer is yes. Will you please repeat it?

Q. Well, it was, in your opinion does this patent disclose or does it not disclose this particular combination of these three things: the flexible base, the abrasive grains, and a binder for securing these grains to the base? A. Yes, it does.

over

Q. In your opinion does this patent or does it not disclose, as to the composition of this binder, that the binder includes a condensation product of a phenolic body and an aldehyde? A. Yes, it does.

* * * * * * *

Q. Also, Mr. Courtney, in your opinion does or does not this Carlton patent disclose as to whether the degree of flexibility of this binder can or can not be changed by the heat treatment given to it? A. It discloses that it can be varied by the heat treatment, yes, sir.

Q. In your opinion would the resin, this binder made according to the disclosure of Carlton, have any flexibility at all? A. With very short heat treatment, shorter than Carlton describes, I think it might have some flexibility.

* * * * * * *

27 Q. In your opinion does the Carlton patent, or does it not, disclose that his resin is set so that it becomes infusible when it is subjected to heat treatment? A. Yes, he does describe rendering it infusible by heat treatment."

Upon redirect examination witness testified that the Carlton patent does not disclose or suggest the use of any resin which is infusible and at the same time flexible.

By Mr. Parker:

"Q. Just one question I should like to ask, Mr. Courtney: In answer to a question which Mr. Miller put to you you said that the Carlton patent discloses the idea that by varying the temperature of cure one can vary the flexibility of the product. Would you kindly tell the Court what details —does Carlton tell how to vary the temperature, within what limits? Does he give any observations by which one skilled in the art could carry out this bare suggestion and obtain differing flexibilities by employing different temperatures? A. I was unable to learn any such thing from Carlton. He describes what he says he found satisfactory conditions. I am not positive of my exact figures here, but my recollection is that it was 15 hours at 145 to 180 or something like that Fahrenheit; and that that may be followed by subsequent heating at a higher temperature, I believe he gives 250 Fahrenheit or something like that, to render the material infusible and insoluble. Those conditions do not produce a flexible film, however."

* * * * * * *

By the Court:

28 "Q. Pardon me just a moment. What do you mean by infusible? A. Infusible, if we are referring to sandpaper, would mean a material which, under the conditions of use and raised to the temperature which it would reach by its friction with the work, would not fuse to the extent that it would pick up the abraded particles from the work and would not load itself full of those abraded particles and thereby become useless.

Q. What causes it to load itself up with the abraded particles? A. If the bonding material were tooo low in melting point, the friction with the work will raise the temperature so that is becomes sticky, and these loose particles that are abraded from the work will then stick to that softened bond and fill up the paper so that it is no longer sharp.

Q. 'Infusible' means 'won't melt'? A. Yes, that is right."

The foregoing is the substance of all of the evidence given on the hearing of this cause.

And upon the conclusion of the taking of the testimony and of the argument of said cause on the 4th day of February, 1935, the Court reserved judgment until the 19th day of February, 1935, whereupon the Court prepared a memorandum in the form in which the same appears elsewhere in this record, indicating that plaintiff's bill would be dismissed.

29 Be it remembered that on March 20, 1935, the defendant submitted to the Court proposed findings of fact and conclusions of law in the form in which the same appear elsewhere in this record as having been on that day made by the Court.

And be it further remembered that the foregoing contains the substance of all the evidence given on the hearing of this cause necessary to the hearing on appeal, and this statement of evidence is duly stated, approved and signed and ordered to be made of record in the above-entitled cause this 10th day of April, 1935.

By the Court:

JOSEPH W. COX,
Justice.

Approved.
T. A. HOSTETLER.

April 9, 1935.

Approved.
POTTER, PIERCE & SCHEFFLER,
By RALPH E. PARKER.

April 10, 1935.

30 390.

Department of Commerce, United States Patent Office.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of Certain Papers under Section 4915 of the Revised Statutes, in the matter of the Pending Application of Lawrence V. Redman, Filed August 19, 1927, Serial Number 214,219, for Improvement in Abrasive Implement.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twenty-third day of January, in the year of our Lord one thousand nine hundred and thirty-five and of the Independence of the United States of America the one hundred and fifty-ninth.

[Seal Patent Office, United States of America.]

CONWAY P. COE,
Commissioner of Patents.

Attest:
D. E. WILSON,
Chief of Division.

No. 6523 - Bakelite Corp. v. Coe. 214219

9/7

PETITION

AUG 19 1927 U.S. PAT. OFFICE

To the Commissioner of Patents:

Your petitioner LAWRENCE V. REDMAN

a subject *of* Great Britain

residing at Caldwell, N.J.

in the County of Essex *and State of* New Jersey

P. O. Address c/o Bakelite Corporation, Bloomfield, N. J.

prays that Letters Patent may be granted to him for improvements in

ABRASIVE IMPLEMENT

set forth in the annexed Specification.

And he hereby appoints **BYRNES, TOWNSEND & BRICKENSTEIN (a firm consisting of Clinton Paul Townsend and John H. Brickenstein), of 918 F Street, N. W., Washington, D. C.,** *Register No. 8562, his Attorneys with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to sign his name to the drawings, to receive the Letters Patent, and to transact all business in the United States Patent Office connected therewith.*

Signed at Bloomfield

in the County of Essex *and State of* New Jersey

this 17th *day of* August 1927

(Sign here FIRST name in FULL) Laurence V Redman

SPECIFICATION

To All Whom It May Concern:

BE IT KNOWN That I, LAWRENCE V. REDMAN

a subject *of* Great Britain

residing at Caldwell, N.J.

in the County of Essex, *and State of* New Jersey

have invented certain new and useful improvements in

ABRASIVE IMPLEMENT

of which the following is a specification:

BYRNES, TOWNSEND & BRICKENSTEIN

This invention relates to abrasive implements, and comprises a novel implement of this character wherein the abrasive grains (silicon carbide, crystalline alumina, emery, sand, etc.) are bonded by an infusible but non-rigid or flexible bonding agent, which for purposes of identification I will term a "flexible phenolic resin". The term "abrasive implement" is used broadly herein to include not only abrasive sheets, discs and other grinding and cutting tools, but also polishing wheels or discs, emery and sand papers and cloths, and the like. It is in these last-mentioned applications, where the abrasive grain is applied to a flexible base such as paper, cloth or felt, that the advantages of my invention are most strikingly exhibited.

Infusible and insoluble resins of the well known phenol-aldehyde type have long been used for bonding abrasive grains for making grinding wheels and other implements. This is disclosed for example in United States patent 942,808 to L. H. Baekeland, and United States patent 1,537,454 to Brock. In these cases, however, and in all prior cases of which I am aware~~,~~ the object has been to provide a strong, hard, infusible, rigid bond for the grains~~.~~. According to the present invention, on the contrary, I provide ~~a~~ an inherently non-rigid or flexible but infusible bond, which not only permits some freedom of movement to the bonded grains when subjected to strain or pressure, but allows these grains to be affixed to such flexible bases as cloth, paper or felt. At the same time, for reasons which insofar as they are understood are explained below, the resulting implements retain to a remarkable degree their initial free-cutting character, as compared with like implements in which the grains are bonded by glue or other substance which melts or softens to a "tacky" state at the working temperature.

It is well known that abrasive papers and cloths as heretofore available, rather quickly lose their free-cutting characteristics in use. This is due to several causes among which are the following:

1 - Under the very considerable rise of temperature due to the friction between the abrasive and the work and the cutting action of the abrasive, the usual bonds soften and flow, coating the grains.

2 - Under the same conditions these bonds become "tacky", and pick up and tenaciously hold both the abrasive dust and the dust from the work, with the result that the interstices between the grains are soon partly or completely filled, and the initial free-cutting character is lost.

I have found that both of these difficulties can be overcome by providing a bond which, although initially flexible, does not fuse nor become tacky at any temperature to which the implement is subjected in use. So far as I am aware no bond having these essential characteristics has been applied heretofore in the manufacture of abrasive implements. Prior bonding materials have either been initially rigid, in which case they could not be applied with advantage to flexible bases: or if initially flexible they have softened unduly under working conditions.

I have found that certain flexible phenolic resins, heretofore used as coating compositions, possess to a very remarkable degree the desirable qualities above indicated; and that when used for bonding abrasive grains in the manufacture of abrasive papers and cloths they yield a product characterized in marked degree by freedom from tendency to fill and clog. (While my invention is not limited to a particular composition of binder I prefer to use for the purpose such flexible phenolic resins as may be prepared, for example, by effecting a reaction between tung oil and phenol in presence of a converting agent or catalyst, and further hardening the resulting phenolic complex to its ultimate infusible state with hexamethylenetetramine or other methylene-containing or aldehyde hardening agent and sufficient application of heat. For example resinous compositions well adapted for the present purpose may be prepared as

BYRNES, TOWNSEND & BRICKENSTEIN

described in United States patent 1,590,079 to Byck. But as stated above my invention is not restricted to the use of this particular composition, but contemplates the employment of any equivalent composition possessing the essential qualities of flexibility at normal as well as higher temperatures, joined with freedom from any substantial tendency to fuse or become tacky at the highest temperatures developed during use.

A further and very advantageous application of these flexible bonding agents is in the manufacture of polishing implements. If a rigid bond is used such abrasive grains as project beyond the rest tend to cut or scratch the work; whereas with the flexible bond such projecting grains yield to the pressure, and a true polishing effect is obtained. The polishing implement may assume various forms according to the character of work to be done. For example it may consist of an assembly of fabric discs, mounted on a central shaft, and each coated around the peripheral portion with the abrasive grains, flexibly bonded as above described. Or it may comprise a metallic or other disc, rotatably mounted, and provided with a heavy felt rim which carries the flexibly bonded abrasive. These polishing implements, like the abrading and cutting tools described above, retain to a remarkable degree their efficiency and free-working characteristics, owing as already explained to the non-flowing character of the bond, and its freedom from tackiness at high temperatures, coupled with a high degree of flexibility at all temperatures.

The above-described flexible phenolic resins possess other advantages. Thus they are unaffected by water or oil, and resistant to most chemicals, to air-oxidation, and to all common solvents. These qualities they possess in common with the resinoids of the phenol-aldehyde type which have long been used for bonding abrasives. Like the phenol-aldehyde resinoids they are infusible at any temperature. But unlike these resinoids they are highly flexible, and hence adapted for such abrading, cutting and polishing purposes as require their attachment to a flexible base or carrier.

No. 6523 - Bakelite Corp. v. Coe.

I CLAIM:

~~1. As a~~ new article of manufacture, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a flexible bond having the essential characteristics of the within-described flexible phenolic resin.

~~2. As a~~ new article of manufacture, an abrasive implement comprising a flexible sheet of fibrous material, and abrasive grains secured thereto by a flexible bond having the essential characteristics of the within-described flexible phenolic resin.

~~3. As a~~ new article of manufacture an abrasive implement comprising abrasive grains and a flexible bond therefor, said bond having the essential characteristics of the within-described flexible phenolic resin.

Cur RWB

AB

AB

In Testimony Whereof, *I affix my signature*

(Sign here FIRST name in FULL) Lawrence V Redman

OATH.

COUNTY OF ESSEX }
STATE OF NEW JERSEY } ss:

LAWRENCE V. REDMAN

the above-named petitioner, being duly sworn, deposes and says that he is a ~~citizen~~ subject *of* Great Britain

and resident of Caldwell, N.J.

and that he verily believes himself to be the original, first, and sole inventor of the improvements in ABRASIVE IMPLEMENT

described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by him or his representatives or assigns in any country foreign to the United States,

~~*excepting as follows*~~

(Sign here FIRST name in FULL) Lawrence V Redman

Sworn *to and subscribed before me this* 17th *day of* August 1927

[Seal here, to be impressed in paper.]

Theodore S. Connolly
(Official Signature.)

Notary Public
(Official Character.)

NOTE.—Acknowledgment should be made before a Notary Public, *who must affix his seal.* If executed before an officer not provided with a seal, the Certificate of the Judge or Clerk of County Court must be affixed, showing official character of such officer.

-29

No. 6523 - Bakelite Corp. v. Coe.

Div. 29 Room 160 Annex HCH:MPB Paper No. 2

Address only
"The Commissioner of Patents,
Washington, D. C."
and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

All communications respecting this
application should give the serial nu
date of filing, and name of
the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

September 12-1927.

G P O 11—6623

Applicant: Lawrence V. Redma

Byrnes, Townsend & Brickenstein,
918 "F" St., N.W.,
Washington, D.C.

Ser. No. 214,219,
Filed Aug. 19, 1927,
For Abrasive Implement

MAILED
SEP 12 1927

This application has been examined.

References made of record:

Crupi,	1,468,960,	Sept. 25, 1923,	51-279,
Okie,	1,635,801,	July 12-1927,	51-279,
Okie,	1,635,800,	July 12-1927,	51-279,
Jackson, (Bri)	208,389,	of 1922	51-280.

The claims do not patentably differ and are rejected on the patents Crupi, Okie and British patent No. 208,389 of 1922.

Examiner.

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THIS ACTION MUST BE RESPONDED TO WITHIN SIX MONTHS.

No. 6523 - Bakelite Corp. v. Coe.

3/1A

Div. 29 - Room 160 Annex

L.V. REDMAN

ABRASIVE IMPLEMENT

Serial No. 214,219

Filed August 19, 1927

FEB 9 1928 U.S. PATENT OFFICE

Washington, D.C.

February 9, 1928.

Hon. Commissioner of Patents

Sir:

Responsive to Official action of September 12, 1927, amendment is made as follows:

Page 2, line 17, after "aware" insert wherein resins of the phenol-aldehyde type have been used

Add the following claims:

~~4. As a new article of manufacture~~, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a bond which is flexible at normal and higher temperatures but infusible at all temperatures, and non-tacky under all conditions of use.

~~5. As a new article of manufacture~~, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a phenolic resin bond which is flexible at normal and higher temperatures but infusible at all temperatures, and non-tacky under all conditions of use.

BYRNES, TOWNSEND & BRICKENSTEIN

REMARKS

The several citations deal with a problem which is doubtless an important one but is substantially unrelated to the particular problem which the present applicant has solved. Hence it is not surprising that there is no substantial similarity between the articles disclosed in the cited patents and that herein claimed.

The patentees deal with the problem of obtaining an abrasive paper or cloth which will work satisfactorily on wet surfaces, primarily to avoid difficulties arising from dust. They require a bond which will retain its strength and toughness when wet, and they allege that they attain this by diverse methods, viz:—

U.S. 1,468,960 Crupi uses a composition of which the base is rosin and glue, dissolved in a menstruum comprising carbolic acid, acetic acid, benzene, etc.

U.S. 1,635,800 Okie uses gums typified by gum Dammar, associated with a vegetable oil and a drier.

U.S. 1,635,801 Okie uses rosin together with a vegetable oil and a drier.

British 208,389 Jackson uses glue or gelatine, insolubilised by treatment with alum, tannic acid, formaldehyde, bichromates or the like.

None of these several compositions are infusible and none are capable of withstanding such rise of temperature as an abrasive paper is subjected to in use without softening materially or becoming "tacky".

The present applicant is working along totally different lines. His bond is indeed waterproof, or highly water-resistant, but that consideration is secondary. His primary purpose is to produce an abrasive paper or like flexible implement which will keep for long periods its initial free-cutting characteristics. His investigations have shown that the loss of this free-cutting power is due at least in large part to the clogging of the interspaces of the grains as the bond becomes tacky under the heating developed by friction and holds the dust derived from the work and the grain. Elimination of this difficulty requires, in the bond, a peculiar and perhaps unique combination of characteristics, in that the bond must be:

flexible at all temperatures

infusible at any temperature

non-tacky at the highest temperature which can be developed in use

None of the bonds disclosed in the cited patents possesses or purports to possess this essential combination of characteristics, and it is clear that none of the patents anticipates the claims.

Claim 4 now presented recites the above characteristics of the bond. Claim 5 recites in addition to these characteristics the chemical nature of the preferred bond,—a flexible phenolic resin.

The case is believed to be clearly allowable and reconsideration and allowance are asked.

Respectfully submitted

Attorneys for Applicant

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#8

(1047)

APPLICATION DIV. SEP 9 30 U.S. PATENT OFFICE

U.S. PATENT OFFICE SEP 10 1930 DIVISION 58

BYRNES, TOWNSEND & BRICKENSTEIN

Div. 58, Room 270-~~Annex~~,
LAWRENCE V. REDMAN.
Serial No. 214,219,
Filed August 19, 1927,
ABRASIVE IMPLEMENT.

Washington, D. C., September 9, 1930.

Hon. Commissioner of Patents.

Sir:

In the matter of the above-identified application, it respectfully is noted that to applicant's assignees there has come, in lawful manner, information of the pendency of two applications, filed by Richard P. Carlton and William Luxmore, respectively, which applications are believed to describe and claim inventions which relate to the same general subject matter as that described and claimed by applicant.

Applicant is of the opinion that the Carlton application in question is the one upon which Patent No. 1,775,631 is about to issue on September 16, 1930, and that the Luxmore application is Serial No. 50,477, filed August 15, 1925.

If any interference is in order between the present application and either of these applications, it is requested that, in accordance with the established practice, such interference or interferences be declared prior to the grant of any patents upon the Carlton and/or Luxmore applications.

Respectfully,

Byrnes, Townsend & Brickenstein

Attorneys.

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Div. 58 Room 270 Annex 260 Paper No. 9

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name

HCH:ERD

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

GPO 11—8633

MAILED
DEC 4 1930

December 4, 1930

Applicant: Lawrence V. Redman
Ser. No. 214,219
Filed Aug. 19, 1927
For ABRASIVE IMPLEMENT

Byrnes, Townsend & Brickenstein,
918 F Street, N. W.,
Washington, D. C.

Responsive to letter filed Jan. 29, 1930.

Additional references made of record:-

Carlton,	1,775,631,	Sept.16, 1930,	(51-280)
Redman,	1,591,999,	July 13, 1926,	(134-50)

The claims in their terms do not present any patentable matter over the patents to Okie and Crupi (of record), as well as over the patents to Redman and Carlton, and they are rejected.

H

Examiner.

35

U.S. APPLICATION DIV.
JUN 4 31
PATENT OFFICE

Division 58, Roo, 270 A.
LAWRENCE V. REDMAN
Serial No. 214,219
Filed August 19, 1927
ABRASIVE IMPLEMENT.

U.S. PATENT OFFICE
JUN 5 1931
DIVISION 58

Washington, D. C., June 4, 1931.

Hon. Commissioner of Patents.

Sir:

BYRNES, TOWNSEND & POTTER

In response to the Office letter dated December 4, 1930, please amend as follows:

Page 2, line 18, after "grains" insert:

> unless modified by high boiling solvents or plasticizers as disclosed in a prior patent to Baekeland 1,019,407, March 5, 1912, or my prior patent 1,107,703, August 18, 1914. Both of these patents describe glycerine and similar modifying agents but plasticizers of this nature have a tendency to reduce the strength or adhesion of the bond to the grains in proportion to the amount of plasticizer included and to cause the resin binder to exhibit an increase in plasticity with a rise in temperature.

•Page 2, line 19, cancel "a" and substitute an inherently

Cancel claims 4 and 5, and add the following new claims:

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No. 6523 - Bakelite Corp. v. Coe.

BYRNES, TOWNSEND & BRICKENSTEIN

Rd 6. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenol-reacted oil resin which, when converted to the infusible stage is flexible in the absence of added plasticizer ~~a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.~~

Od 7. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenol-reacted oil further reacted with aldehyde to form a flexible, infusible, insoluble bond ~~a phenolic resin which when converted to the infusible stage is flexible in the absence of added~~ plasticizer.

Od2 X 8. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including the reaction product of a phenol with oil and a methylene-containing agent. and characterized by inherent flexibility and insolubility.

//

X # Rd 2 9. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenol- ~~an~~ oil-resin reaction product.

Odd 3

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REMARKS.

Favorable consideration of new claims 6 to 9, inclusive, respectfully is requested.

The new claims 6 and 7 define the invention as residing in the provision of a flexible sandpaper (or equivalent abrasive implement) in which the bond is an inherently flexible phenolic condensation product: according to claims 8 and 9 the said bond is an oil-resin reaction product. Ample basis for these claims is found in the original description. That the said new claims patentably distinguish the present invention from the cited prior art is believed to be established in the following:

As has been pointed out in the specification, the prior art sandpaper binders have either been initially rigid (in which case they could not be applied with advantage to a flexible base) or if initially flexible they have softened unduly under working conditions. Where the binder has been a phenolic resin modified for the sake of flexibility by the addition of a high boiling solvent or plasticizer (e.g., glycerine), the modifier has undesirably reduced the strength or adhesion of the bond to the grains, which reduction in adhesion has been in proportion to the amount of added modifier: also, the addition of a modifier has caused the binder to increase in plasticity with rise in temperature. Many of the prior art sandpaper bonds were detrimentally affected by either water or oil or both, and in general the sandpapers of the prior art quickly lost their free-cutting characteristics in use.

To overcome these disadvantages, applicant provides a sandpaper having a bond which is initially flexible, infusible, non-tacky at elevated temperatures, unaffected by water and by oil, and resistant to all common solvents, to most chemicals, and to air-oxidation. The bond having these desirable characteristics is a phenolic resin product which is inherently non-rigid in both intermediate and final stages -- specifically, the resinous product obtained by reacting tung oil with a phenol in the presence of a converting agent or catalyst, and hardening the resulting phenolic complex to its ultimate infusible state by heating the same with a methylene-containing hardening agent (such, for instance, as formaldehyde, hexamethylenetetramine, or the like).

Such an inherently flexible infusible bond is not disclosed in or suggested by the cited prior art. Okie uses (U.S. Patent 1,635,800) gums (e.g., gum dammar) associated with a vegetable oil and a drier; or (U.S. Patent 1,635,801) rosin associated with vegetable oil and drier. Neither of these compositions is infusible: each, under the conditions of use, softens materially and becomes "tacky" Crupi's composition (rosin and glue dissolved in an organic menstruum) likewise is fusible and subject to "tackiness" and flow under conditions of use.

The Carlton bonds are phenolic resins which may be modified for the sake of flexibility by the addition of a high boiling solvent or plasticizer. The patentee discloses three methods for the preparation of the bonding material. In those instances where a resin is described, and denominated as being flexible, it will be noted from a consideration of the disclosed process of manufacture that the resin per se is flexible only in the intermediate stage but not in the final stage. In other words, if one uses the resin described by patentee without resorting to the addition of a plasticizer one either (1) sacrifices infusibility and insolubility (attributes of a "C" type Bakelite resin) for flexibility and avoids conversion of the resin to the final stage, or (2) sacrifices flexibility (an attribute of the "B" type resin) for infusibility and insolubility and carries the conversion of the resin into the final stage. Of these facts relative to the well-known Bakelite resin the Examiner undoubtedly is aware already. Flexibility is not an inherent characteristic of Carlton's resin product, but is due only to the fact that the "B" type resin product contains a material amount of free phenol which temporarily acts as a plasticizer: upon further heating (or even merely upon standing for some time) the resin of the intermediate stage becomes hard and loses its flexibility. Patentee does disclose, however, a method of making the "C" type resin flexible; i.e., by incorporating in the resin "various modifying agents" such as "glycerol, starch, dextrin, sugar, proteins, castor oil, or shellac" (page 2, lines 105 to 115, of the patent). It is only by recourse to an added plasticizer that Carlton's resins can be made flexible and yet be infusible. And such compositions (i.e., phenolic resin plus glycerol or an equivalent modifying agent) exhibit an undesirable reduction in adhesion to the abrasive grains and an increased plasticity with rise in temperature.

Applicant has carried out precisely the process described by patentee beginning page 3, line 81, of the patent, stopping the reaction in three separate samples after various periods of reaction each falling within the directions of patentee (page 3, lines 91 to 98).

Sample 1 was heated for a long time at Carlton's preferred temperature, obtaining the separation described by Carlton;

Sample 2 was heated in same manner as was sample 1, and then was heated for one hour at 275° F.; while

Sample 3 was heated for a much longer time than were samples 1 and 2, so as to obtain the product described by patentee as having the "consistency of soft pitch".

Sample 1 was too soft for use as an abrasive bond, and did not have sufficient bonding power to permit its use in making sandpaper.

Sample 2 provided a fair bond, but was too brittle for use. It could be made "passable" by adding one or another of the plasticizers repeatedly mentioned by patentee (and that, we believe, was what Carlton intended).

Sample 3 provided a good bond, but was not flexible. An added plasticizer would be necessary to confer flexibility.

Applicant's bonding material, however, is a wholly different resinous product being, when in the "C" stage, inherently flexible and extremely adhesive toward both abrasive grains and base. His preferred bonding material is a phenol-oil-methylene condensation complex -- that is to say, an "oil resin" -- whereas Carlton's bond either is

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BYRNES, TOWNSEND & BRICKENSTEIN

a straight "Bakelite" resin or else is a "Bakelite" resin modified by admixture of a plasticizer therewith, and in neither case is his resin inherently flexible in the infusible state.

Nor does the Redman patented coating composition anticipate the invention defined by the present claims, since it too involves the use of a plasticizer (e.g., furfural) with a phenolic resin which is not inherently flexible in the final or "C" stage. Moreover, patentee does not suggest the possibility of using his resin-furfural mixture as a bond for sandpaper, and does not suggest a flexible bond for sandpaper.

In view whereof, it respectfully is urged that the invention as defined by the present claims is not anticipated by the cited references, but is marked by a patentable advance thereover.

Allowance is, therefore, requested.

Respectfully,

Byrnes, Townsend & Brickenstein

Attorneys for Applicant.

Div. 58 Room 270 Annex Paper No. 11

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name

CRC:ERD

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant

MAILED
OCT 6 - 1931

October 6, 1931

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

Applicant: Lawrence V. Redman
Ser. No. 214,219
Filed Aug. 19,1927
For ABRASIVE IMPLEMENT

Byrnes, Townsend & Brickenstein,
918 F Street, N. W.,
Washington, D. C.

Responsive to amendment filed June 4, 1931.

Additional reference:

Byck, 1,590,079, June 22, 1926, (134-26)

Claims 6 to 9, inclusive, are rejected as being for an exhausted combination of elements, i. e., a flexible base, abrasive and a synthetic resin binder. If there is any novelty set forth, it would appear to be in the resin per se and not in the combination.

Claims 6 and 7 are further rejected as being met by patent to Carlton. Carlton discloses a phenol-aldehyde flexible resin as a binder between the grit and backing.

Claims 8 and 9 are further rejected as being met by patent to Carlton in view of patent to Byck. No invention is seen in using the resin of the Byck patent as a binder in the Carlton patent.

CRC

E. F. Dowell
Examiner.

214219 20 R

No. 6523 - Bakelite Corp. v. Coe.

Amdt + Samples + affidavit

12/D Not Entd

APR -5 32

DIVISION 58 APR 6 1932 U.S. PATENT OFFICE

BYRNES, TOWNSEND & BRICKENSTEIN

Division 58, Room 5605,
LAWRENCE V. REDMAN
Serial No. 214,219
Filed August 19, 1927
ABRASIVE IMPLEMENT.

Washington, D. C., April 5, 1932.

Hon. Commissioner of Patents.

Sir:

In response to the Office letter dated October 6, 1931, please amend as follows:

Claim 6, cancel lines 5 to 8, inclusive, and substitute the following:
a phenol-reacted oil resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

Claim 7, cancel lines 5 to 7, inclusive, and and substitute the following:
a phenol-reacted oil further reacted with an aldehyde to form a flexible, infusible, insoluble bond.

Claim 9, line 5, insert phenol- before "oil".
change "an" to a.

REMARKS

Favorable reconsideration of claims 6 to 9, inclusive, respectfully is requested. It is noted that claims 6, 7 and 9 have been amended in conformity with the Assistant Examiner's suggestions as expressed during an interview accorded applicant's attorneys on or about December 19, 1931. Also, there is attached hereto an affidavit, prepared by an expert in this art, establishing certain important differences between the product of the present invention and the sandpaper of the cited prior art. It is the understanding of applicant's attorneys, as the result of the aforesaid interview, that the claims as now amended are proper definitions of a patentable invention.

The claims are believed to define a patentable combination in that they are drawn to a new and unobvious result -- i.e., a sandpaper which is flexible and non-softening in use, and in which the abrasive grains are tenaciously fixed onto the flexible backing or base.

Claim 8 and amended claim 9 are understood to distinguish patentably from the cited prior art. It respectfully is submitted that it was unobvious to adapt the resinous product of the Byck patent to use as a bond in an abrasive implement: patentee suggested non-analogous functions or uses for his product, and it required the exercise of inventive genius on the part of applicant to conceive of using a phenol-oil-resin as a bond for abrasive grains in an abrasive implement. It will be apparent that one skilled in this art could not have foretold whether or not such an insulating material would have been operable in preparing a flexible sandpaper.

2 [illegible] 9 22

Amended claims 6 and 7 likewise are understood to define an invention which is not disclosed in or suggested by the Carlton patent of record. Patentee did, indeed, disclose a phenol-aldehyde resin binder, but obviously not a resin binder which is inherently flexible or flexible in the absence of added plasticizer. Patentee specifically stated that flexibility had to be imparted to the bond by association therewith of "various modifying agents"; these merely mechanically associated agents included "glycerol, starch, dextrine and sugar on the one hand, and various proteins, castor oil and shellac on the other hand". Applicant's binder is distinguished therefrom in that it is "a phenol-reacted oil resin which, when converted to the infusible stage, is flexible in the absence of added plasticizer", or, expressed in a somewhat different manner, is "a phenol-reacted oil further reacted with an aldehyde to form a flexible, infusible, insoluble bond".

Supporting these distinguishing characteristics there is filed herewith an affidavit prepared and executed by Dr. H. L. Bender. Therefrom it will be observed that Dr. Bender prepared sandpaper in strict accord with the Carlton patent disclosure (identified as samples "XK-2636" and "XK-2637" submitted herewith) and likewise with the process described by applicant (identified as samples "XK-2720" and "XK-2723" submitted herewith). His experiments establish that the sample "XK-2636" contained a heat-sensitive bond which was flexible when undercured but which became brittle upon aging at room temperature or upon further heating to complete the condensation of the resinous binder. The binder was not insoluble, being dissolved readily by hot acetone (a standard test for solubility of a phenol-aldehyde resin). The castor oil-modified product -- i.e., sample "XK-2637" -- was initially flexible but the castor oil separated from the resin upon aging or upon completion of the condensation of the resin; furthermore, the castor oil addition materially depreciated the product in that it weakened the bonding strength of the binder, and coated the abrasive grains and permeated the paper backing.

In contradistinction thereto, the samples "XK-2720" and "XK-2723" prepared with the phenol-oil-resin binder described by applicant are strongly bonded, stable in heat as well as cold, resistant to solvents and to water, and inherently flexible: this binder remains homogeneous and flexible under all conditions of use, aging, etc. It has a greater flexibility than the Carlton product even when the latter is tested as freshly prepared.

Wherefore, it is established that the present claims define a product which is not suggested by the Carlton patent and which is patentably distinguished therefrom.

Allowance is, accordingly, requested.

Respectfully,

Byrnes, Townsend & Potter

Attorneys for Applicant.

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APR -5 32

U. S. PATENT OFFICE
APR 6 1932
DIVISION 58

AFFIDAVIT OF HOWARD L. BENDER

COUNTY OF ESSEX)
: SS
STATE OF NEW JERSEY)

HOWARD L. BENDER , being duly sworn, deposes and says:

1. That he is a citizen of the United States, and resident of Bloomfield, County of Essex, State of New Jersey;

2. That he is familiar with the art of making phenol-aldehyde resins, having had about eight years' experience in research and development work thereon;

3. That he is familiar with the improvement in Abrasive Implements described and claimed in the application for Letters Patent Serial No. 214,219 filed by Dr. L. V. Redman on August 19, 1927, and that he is acquainted with the subject matter of United States Patent No. 1,775,631 to Carlton;

4. That he made and tested several samples of sandpaper in accordance with the processes described by the aforesaid applicant and the aforesaid patentee, including the samples identified as "XK-2636" and "XK-2637" in accordance with the process described in Patent No. 1,775,631, and the sample identified as "XK-2720" in accordance with the process described in Redman Application Serial No. 214,219;

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5. That the aforesaid samples were made, and observed, as follows:

XK-2636 - Made from a Kraft wrapping paper approximately 3 mils thick coated with a liquid resin made as per example of the Carlton Patent, U.S. 1,775,631.

This liquid resin was made from 300 grams phenol
300 " 37.5% formaldehyde solution
30 grams anhydrous zinc chloride

heated under reflux at 46° C. (159° F.) for 129 minutes. A separation occurred at the end of 51 minutes but the heating was continued since the resin layer was entirely too penetrating into paper.

After 129 minutes a yield of 403 grams of resin layer was obtained. This resin layer was used as a bonding agent to make sandpaper out of the 3 mil paper and 180 mesh grit.

After the paper was evenly coated with the resin "Carborundum" grit of 180 mesh size was dusted on in excess. The excess was then shaken off leaving those particles which were stuck to the resin layer. Some of the same resin layer was diluted slightly with alcohol and sprayed over the top of the adhering grit. The whole was then heated to dry and cure the bond.

Samples were cured under various conditions and sandpaper cured 30 minutes at 135° C. was found to check closely with sandpaper cured 15 hours at 74° C. (165° F.).

The sample XK-2636 was cured fot 15 hours at 74° C. as recommended by Carlton.

The sandpaper so made contained a heat sensitive bond which was left undercured. Such paper became very brittle with additional heating and also with age at room temperature.

XK-2637 - This sample was made from the same resin layer as XK-2636 except that the resin layer was mixed with castor oil. One hundred parts of the resin layer were mixed with 20 parts of the castor oil, then samples were made exactly as described under XK-2636 above.

XK-2720 - A varnish was made according to the Byck process as follows:

100 parts phenol
150 " tung oil
1 " 85% phosphoric acid.

These were reacted 120 minutes at 180° C. This reaction product was suspended in a mixture of alcohol and butanol. 20 parts hexamethylenetetramine were added and the whole reacted until a 65% solid content varnish reached a viscosity of 1,000 centipoise.

The varnish was then diluted with alcohol as desired for application to the paper. The dilution used varied with the method used for application.

The paper was given a light coating of varnish, then heated five minutes at 130° C. A thick coat of varnish was then applied to one side with a printing roll. While still wet excess grit was dropped on the varnish and the excess then jarred off. The grit covered paper was then run through an oven for 30 minutes at 135° C. A light coat of the varnish was then applied over the top of the grit and the paper again run through an oven at 135° C. for 30 minutes.

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The product obtained in this way is a very good waterproof sandpaper which does not change on standing. Samples made like this have been tested over a period exceeding five years and found not to deteriorate.

6. That the sample identified as XK-2723 is a sample of a commercial run of sandpaper, which he is informed and believes was made in 1929 using a "Bakelite" binder, marketed by Bakelite Corporation under the notation "XV-1410 'Bakelite' Varnish", substantially identical with the binder described hereinbefore under the heading "XK-2720". He understands and believes that in the making of this sandpaper the grit used was size 180 mesh "Carborundum" grit.

7. That his investigations of the four samples of sandpaper above identified show that the binder employed in making samples "XK-2636" and "XK-2637" is in one of two forms, to wit:

1. A standard phenol-aldehyde condensation product used as a sandpaper bond exactly as Baekeland disclosed, except that the resinous bond was left under-reacted in order to gain softness or flexibility.

This product shows all the characteristics of a Bakelite "A" left unreacted or only partly reacted. It is very sensitive to temperatures above room temperatures becoming brittle in a few minutes at any temperature above 100° C. It spoils by becoming brittle in a few months even at room temperatures.

2. The condensation product of 1 above, modified by mechanical admixture with a known plasticizing agent.

It is not a strong bonding agent since the condensation product is purposely left in the soft intermediate stage. It is well known that Bakelite "A" goes through the three stages:

First, a soft stage where it is fusible and soluble.

Second, a "B" stage where it is semi-rigid when hot, brittle when cold and lacks strength.

Third, a "C" stage where it is rigid both hot and cold and is characterized by insolubility and toughness (or strength).

8. That he tested the aforesaid product as made in accordance with the directions of the aforesaid patent and found it to be soluble in hot acetone even after cured. The same sample heated an additional 30 minutes at 135° C. was very brittle but on test was found to be insoluble in hot acetone.

9. That he further found that the primary product used in making samples XK-2636 and XK-2637 could be modified by adding high boiling solvents such as castor oil. This product acts as plasticizer as long as it remains in solution. However, in all cases the Bakelite "A" eventually hardens to a point of insolubility and the two separate. The plasticizer dilutes the bonding strength so that even poorer bonds are found here than under the undiluted case above. All the other faults of the under-cured bond are found here with the additional fault of separation of the plasticizer.

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10. That the product typified by samples "XK-2720" and "XK-2723" is a hot and cold stable, strongly bonded, product in which the water and solvent resistant bonding agent remains as a homogeneous flexible mass under extreme treatment. It is more flexible than the product of XK-2636 and XK-2637, and retains this extreme flexibility under very severe conditions. It does not become brittle or segregate oil on heating or aging, nor does it yield to solvent treatment with hot acetone.

Howard L. Bender
HOWARD L. BENDER

Sworn to and subscribed before me this 30th day of March, 1932.

Theodore A. Connolly
Notary Public.

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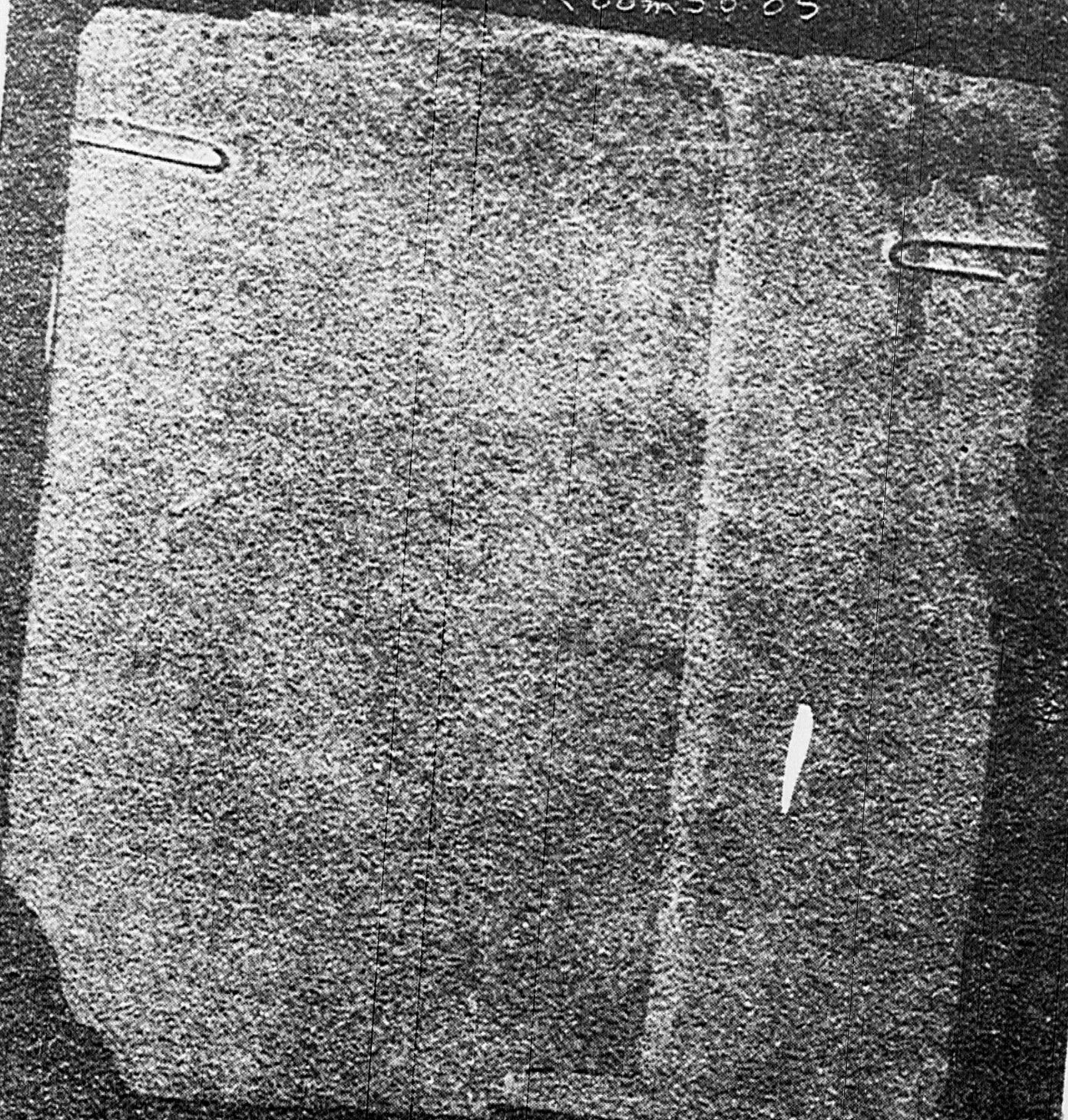
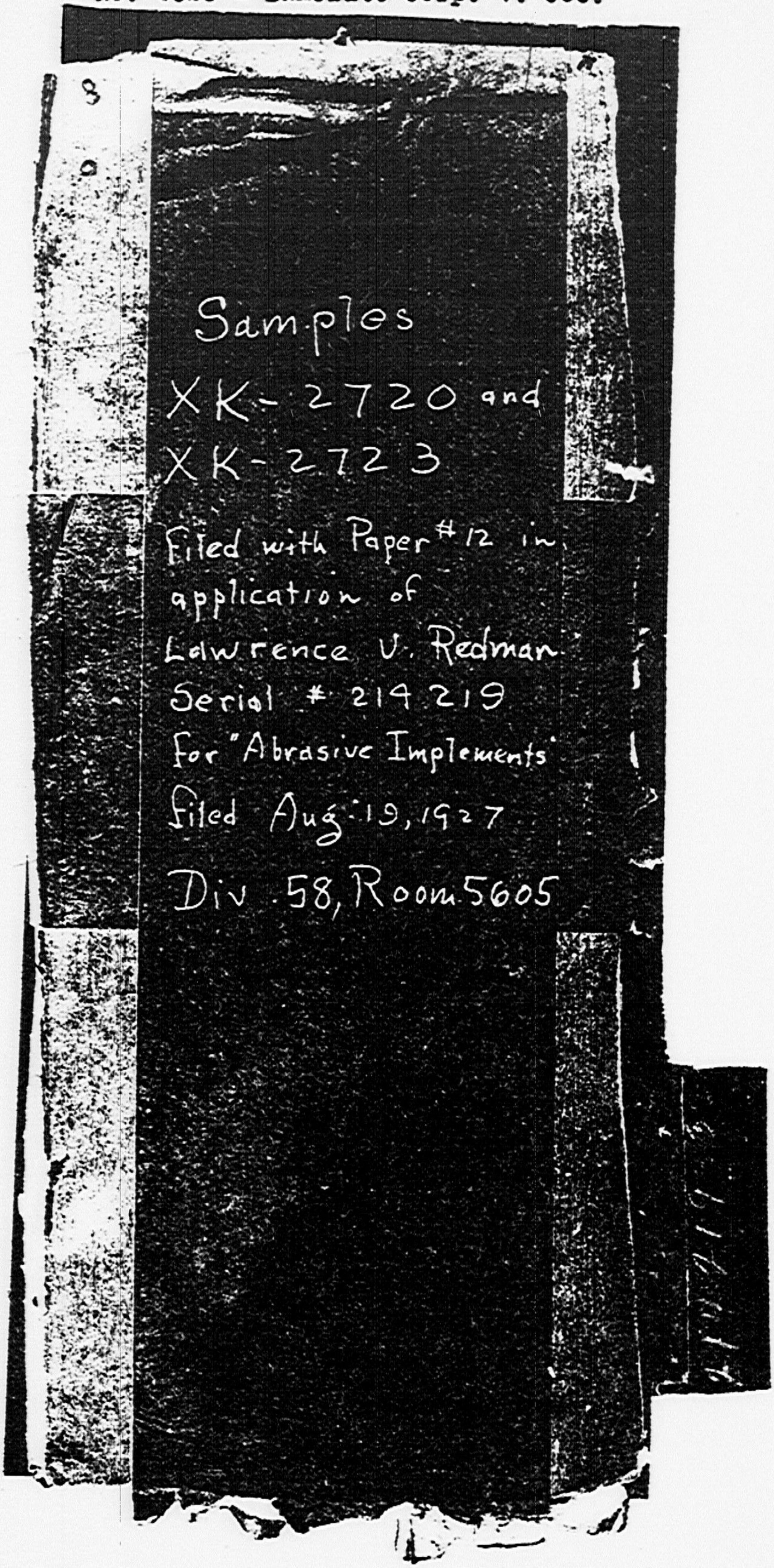
Samples

XK-2636 and
XK 2637

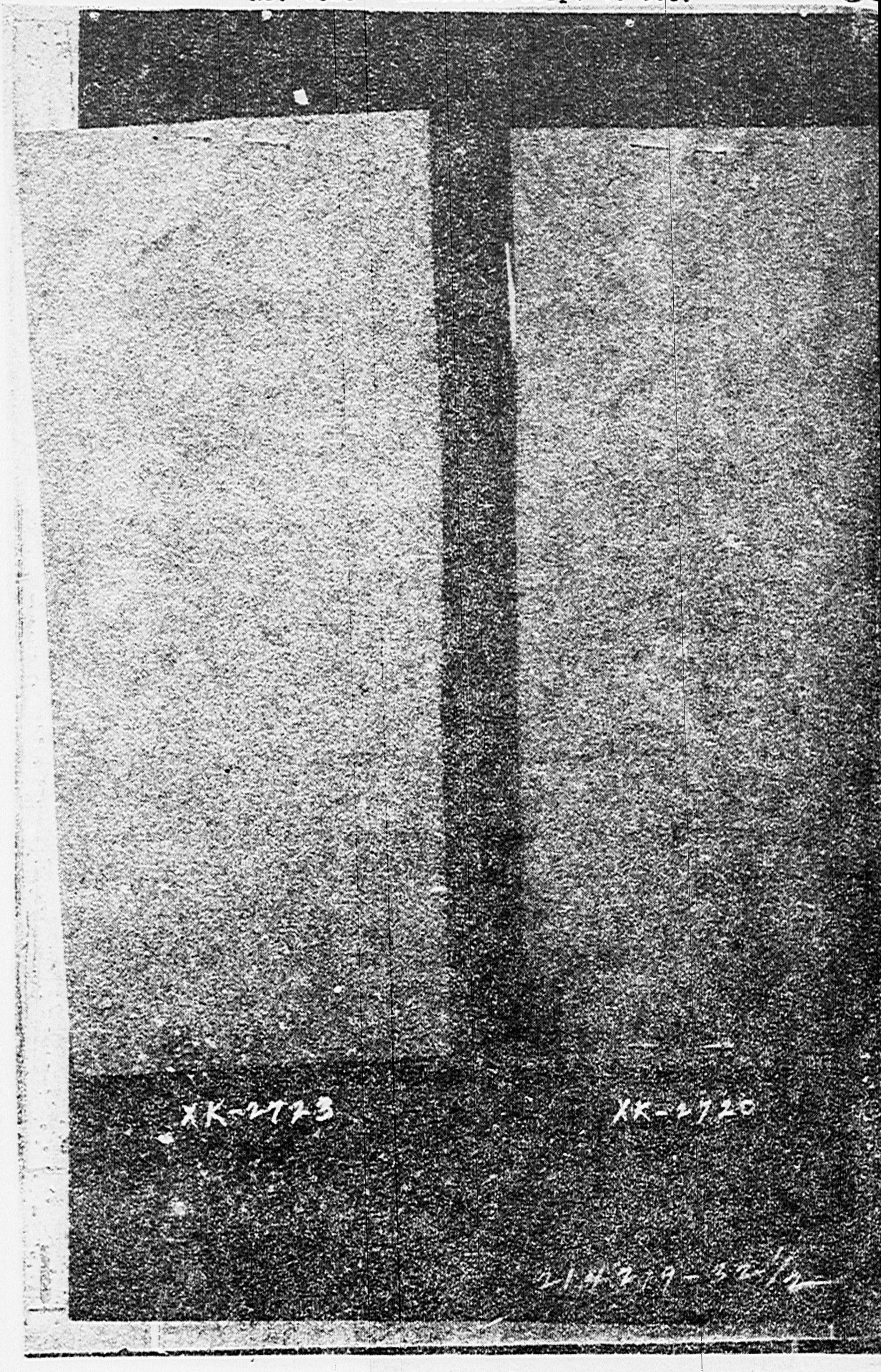
filed with Paper #12 in
application of
Lawrence V Redman
Serial # 214219
for Abrasive Implements
filed Aug 19 1927

Div 58 Room 5605





Samples
XK-2720 and
XK-2723
Filed with Paper #12 in
application of
Lawrence V. Redman
Serial # 214.219
For "Abrasive Implements"
filed Aug. 19, 1927
Div. 58, Room 5605


XK-2723
XK-2720
2.14.27.9-32-1/2

No. 6523 · Bakelite Corp. v. Coe.

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Frw Exr 4/13

APPLICATION DIV.
JUL -6 32
PATENT OFFICE

U.S. PATENT OFFICE
JUL 7 1932
DIVISION 58

IN THE UNITED STATES PATENT OFFICE.

Div. 58, Room 5605,
In re application of
LAWRENCE V. REDMAN
Serial No. 214,219
Filed August 19, 1927
ABRASIVE IMPLEMENT.

SUPPLEMENTAL AMENDMENT

Washington, D. C.,
July 6, 1932.

Hon. Commissioner of Patents,
Washington, D. C.

SIR.

BYRNES, TOWNSEND & POTTER

Supplemental to the amendment filed April 5, 1932, kindly further amend as follows:

Cancel claims 6 and 7.

Add the following new claims:

~~10. As a new article~~ of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.

E'

~~11. As a new article~~ of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

Cancelled

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REMARKS.

New claims 10 and 11, submitted by the present amendment, are identical with the original phraseology of claims 6 and 7, respectively. Claims 6 and 7, as amended, have been cancelled. Favorable reconsideration of these claims respectfully is requested.

Applicant respectfully would submit that the definitions of the present invention afforded by claims 10 and 11 are both proper and accurate; they are, moreover, strictly limited to the actual subject-matter described herein. At the time this application was filed "inherently flexible phenolic resins", or "phenolic resins which when converted to the infusible stage were flexible in the absence of added plasticizer", were known in the resin art. While the applicant preferably uses the specific "innerently flexible"resin defined in claims 8 and 9 (understood to be allowable), he justly is entitled, it is believed, to claim the compositions defined by claims 10 and 11, in view of the definite reference in the specification (see page 3, lines 20 to 25 inclusive; page 4, lines 2 to 7 inclusive, and lines 25 to 33 inclusive) to inherently flexible resins theretofore used as coating compositions.

The new claims, moreover, call for a binder consisting of a resin containing no added plasticizer, but which is per se inherently flexible in the infusible stage, in combination with abrasive grains and a flexible base; the combination being in the form of an abrasive implement in which the binder adheres to the base and in turn is the "matrix" for retaining the abrasive grains. While it, of course, was known to use as such binder a phenol-aldehyde resin it was not heretofore taught or suggested to use as the binder an inherently flexible resin. Thus, for instance, in the cited patent to Carlton those skilled in this art were taught either to use an *incompletely reacted* resin (which in the *infusible* stage is brittle and not flexible) or else *to plasticize* the normal phenol-aldehyde resin with named plasticizers. As has been established by the affidavit filed herein on April 5, 1932, neither of these two expedients is equivalent in effect to, or suggestive of the results attained by, the use of a resin which is inherently flexible, even in the infusible stage, in the absence of added plasticizer. Clearly then, the invention defined by claims 10 and 11 was, along with that of claims 8 and 9, unpredictable and inobvious from a knowledge of, and contradictory to, the Carlton patent. Such an invention of course is not an exhausted combination for the same reason, viz.: that the said combination is novel and is characterized by highly advantageous and unpredictable characteristics.

Wherefore, it respectfully is requested that claims 8 to 11, inclusive, be favorably reconsidered and allowed.

Respectfully,

Byrnes Townsend & Potter
Attorneys.

Div. 58 Room 5613

Paper No. 15

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name

EFD:ERD

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

July 12, 1932

Applicant: Lawrence V. Redman

Ser. No. 214,219
Filed Aug. 19, 1927
For ABRASIVE IMPLEMENT

Byrnes, Townsend & Potter,
1319 F Street, N. W.,
Washington, D. C.

MAILED
JUL 12 1932

Responsive to amendment filed July 6, 1932.

Claims 10 and 11 (which are claims 6 and 7 restored by amendment) are again rejected on patent to Carlton, which clearly discloses a flexible condensation product of phenol and an aldehyde. It is to be noted that applicant's reaction product includes more than the phenol and aldehyde. The oil appears to be very essential while lines 29 to 31 of Page 3 of applicant's specification identify the aldehyde as a hardening agent.

Claims 8 and 9 are allowable as at present advised. The present action is made final.

Examiner.

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U.S. PATENT OFFICE

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Rec'd

Paper #16
15.00

IN THE UNITED STATES PATENT OFFICE

In re Application of
LAWRENCE V. REDMAN ✓

For "Abrasive Implement"

Serial No. 214,219 ✓

Filed August 19, 1927.

Washington, D. C.,
January 12, 1933.

BYRNES, TOWNSEND & POTTER

APPEAL TO THE BOARD OF APPEALS

Hon. Commissioner of Patents.

SIR:

I hereby appeal to the Board of Appeals from the decision of the Principal Examiner in the matter of my application for Letters Patent for an improvement in "ABRASIVE IMPLEMENT", filed August 19, 1927, Serial No. 214,219, which on the 12th day of July, 1932, was finally rejected.

The following are the points of the decision on which appeal is taken:

1. The Examiner erred in rejecting claims 10 and 11.
2. The Examiner erred in not allowing claims 10 and 11.
3. The Examiner erred in holding that the disclosure in U.S. Patent No. 1,775,631 to Carlton anticipates the subject matter of claims 10 and 11.

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BOARD OF APPEALS
JAN 13 1933
U.S. PATENT OFFICE

214219 37 R

BYRNES, TOWNSEND & POTTER

4. The Examiner erred in holding that applicant's invention is limited to the use of a phenol-oil-aldehyde resin.

The statutory fee of $15.00 is attached hereto.

An oral hearing is requested.

Respectfully,

LAWRENCE V. REDMAN

By Byrnes Townsend & Potter

His Attorneys.

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CRC:ERD

Paper No. 17

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON, D. C.

January 18, 1933

MAILED
JAN 18 1933

In re application of
Lawrence V. Redman,)
Serial No. 214,219,)
Filed Aug. 19, 1927,)
For: Abrasive Implement)

Before the
BOARD OF APPEALS

****

EXAMINER'S STATEMENT

****

Applicant appeals from the action of the Examiner, finally rejecting claims 10 and 11, which read as follows:

> 10. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.

[illegible]

> 11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

The reference is patent to:

Carlton, 1,775,631, Sept. 16, 1930

The invention called for by these claims consists of an abrasive sheet of the nature of sandpaper in which the abrasive grains are cemented to a flexible backing sheet by a phenol-aldehyde synthetic resin.

Claims 10 and 11 were rejected as being met by patent to Carlton.

Patent to Carlton discloses an abrasive body consisting of a sheet of flexible material for a backing element and a flexible binder consisting of a phenolic body and an aldehyde for fastening the abrasive grains to the backing sheet.

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The rejection of claims 10 and 11 on patent to Carlton is believed to be proper. Carlton discloses an abrasive sheet, which has the abrasive fastened to the backing by means of a flexible phenol-aldehyde resin. The claims call for an abrasive sheet, which has the abrasive fastened to the backing by means of a flexible phenol-aldehyde resin. These two claims are very broad and if there is any difference between the article of these claims and that of the reference, the claims do not point out such a difference as is required by Sec. 4888 U.S.R.S.

E.R.G.

Respectfully,

E. F. Dowell
Examiner, Div. 58

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U. S. PATENT OFFICE
BOARD OF APPEALS
JUN 5 - 1933
MAILED

Appeal No. 8280 Paper No. 20
Decision.

Appeal No. 8280

OVT

Hearing:
May 4, 1933

IN THE UNITED STATES PATENT OFFICE

BEFORE THE BOARD OF APPEALS

Ex parte Lawrence V. Redman

Application for Patent filed August 19, 1927, Serial No. 214,219. Abrasive Implement.

Messrs. Byrnes, Townsend & Potter for applicant.

This is an appeal from the action of the examiner finally rejecting claims 10 and 11.

Claim 11 is illustrative:

> 11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

The reference relied upon is:

Carlton	1,775,631	Sept. 16, 1930

Applicant's purpose is to provide a non-rigid or flexible bond of phenolic resin type to secure abrasive grains to a flexible base in the formation of abrasive implements of the type of emery paper. He prefers to use the reaction product of phenol and tung oil which product

214219 41 R

is hardened with hexamethylenetetramine or other methylene-containing or aldehyde hardening agent. As a specific example the specification refers to the resinous compositions described in the patent to Byck No. 1,590,079.

The examiner has allowed claims 8 and 9 which are quite similar to the claims on appeal but require a phenol-oil-resin reaction product. He regards the appealed claims as being so broadly drawn as failing to patentably distinguish from the patent to Carlton.

Carlton, like the applicant, is concerned with the production of flexible abrasives of the sand paper type and employs similar synthetic resins either alone or with modifying agents to increase the flexibility of the cured binder. Applicant urges that in the former case Carlton obtains a flexible binder only because it is under-cured and in the latter case in which a plasticizer is used, the appealed claims are not met since they require a flexible binder in the absence of added plasticizer. We are not satisfied that the difference, if any exists, is more than a difference in degree. Lines 32-45 inclusive, page 4 of the patent, indicate that a flexible binder of the desired resistance to solvents and heat is secured without the addition of a plasticizer. Applicant's product is described at the top of page 4 of the application as being free from substantial tendency to fuse or become tacky at the highest temperatures developed during use. Furthermore the Byck patent emphasizes the plasticizing effect of the tung oil employed in the composition. It seems to us in view of this state of facts that applicant is not entitled to the appealed claims but on the other hand the claims which have

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been allowed him by the examiner furnish protection commensurate with the advance he has made in the art.

The decision of the examiner is affirmed.

M J Moore
Assistant Commissioner)
Eugene Landers.
Examiner-in-Chief) BOARD OF APPEALS
H L Thurber
Examiner-in-Chief)

June 5, 1933

214219

43 R

75 & 76

Bakelite Corporation vs. Coe.

Equity No. 56,517.

A—Low, 1,243,312.
B—Crupi, 1,468,960.
C—Byck, 1,590,079.
D—Redman, 1,591,999.
E—Martin, 1,626,246.
F—Carlton, 1,775,631.
G—Examiner's Statement.
H—Decision of Board of Appeals.
I—Baekeland, 942,808.

UNITED STATES PATENT OFFICE.

FRANK S. LOW, OF BUFFALO, NEW YORK.

PROCESS OF HARDENING RESINS AND PRODUCTS THEREOF.

1,243,312. Specification of Letters Patent. **Patented Oct. 16, 1917.**

No Drawing. Application filed January 31, 1916. Serial No. 75,425.

To all whom it may concern:

Be it known that I, FRANK S. LOW, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Processes of Hardening Resins and Products Thereof, of which the following is a specification.

This invention relates to processes of hardening resins and products thereof; and it comprises a method of hardening and stabilizing the softer natural resins, such as dammar resin, the soft copals and the like, and more particularly of hardening ordinary rosin or colophony, by producing an internal change in such resins with the aid of reactive chemicals, heat and pressure, wherein such a soft resin is heated to a comparatively high temperature under a suitable pressure, in the presence of active vapors or gases containing materials capable of readily uniting with reactive groups or components of such resin, as, for example, sulfur vapors or formaldehyde vapors, but more particularly formaldehyde vapors; and it comprises as a new material, a hard varnish resin resembling a hard copal and possessing the properties of a hardened and stabilized soft natural resin, such as colophony; all as more fully hereinafter set forth and as claimed.

There are large supplies of comparatively "soft" natural resins, such as rosin, gum dammar and the "soft" copals, such as Manila copal, commercially available which however are not deemed highly desirable components of varnish. These resins are called "soft", not because they are, necessarily soft at all temperatures, for many of them, like rosin are hard when cold, but because they are low melting resins which under conditions of use are, or may become, soft. Common rosin or colophony, for instance, makes when used with a suitable solvent a varnish film which softens and becomes tacky even at ordinary summer temperatures. And rosin varnish, like varnishes made from the other soft resins, is apt to fissure and scale off in time. Many efforts have been made to obviate these defects in the case of rosin, since not only is it a cheap resin but it gives a brilliant varnish of good appearance. These efforts however have not been particularly successful in the sense of giving a high grade varnish. Rosin contains acid constituents and for the most part, the experiments of the prior art have been in the direction of converting these acid constituents, partially or wholly, into their salts, such as the lime salts, the zinc salts, etc. These salts have a higher melting point than that of the rosin acids from which they are derived and an addition of bases therefor hardens the rosin to a certain extent; it enables it to form varnish films which will stand a summer temperature or the body temperature without becoming so sticky or tacky as is the case with untreated rosin. But in so hardening the rosin, the other defects of fissuring and perishability are not substantially bettered; the new products formed retain the character of the original rosin in this respect. Combining the acid groups with a base does not, of course, affect in any way the unsaturated groups to which the perishability is due. Similar difficulties obtain with the other soft varnish gums, not all of which are as acid in their nature as rosin. Not being so acid, naturally they cannot take up so much base and cannot be hardened to the same extent as rosin.

The perishability or alterability of these soft resins when used as varnish under atmospheric conditions, *i. e.*, when spread out as thin films exposed to light, air and moisture, is due, in the main at least, to the presence of readily reactive groups or components which undergo slow oxidation and chemical change.

In the present invention I have devised a process of improving the stability of these soft resins by what may be termed an accelerated aging in which I cause these alterable groups or components to be attacked by reactive vapors at high temperatures and pressures whereby the treated rosin is made insensitive to oxidation and similar changes when it is later used under varnish conditions. In so doing, I produce a union with or change of such alternable constituents or groups of the resin by, or under the influence of, such reactive chemicals. And I find that I achieve not only the highly desirable result of rendering the rosin or other soft resin permanent and stable as a varnish film but also the unexpected result of materially raising the melting point and thereby converting the soft resin into a hard resin: into a resin of the type of those which are known as the hard copals. For example, in treating rosin by the present process, its melting point is raised to a degree where varnishes made with it do not become tacky under atmospheric conditions. The rosin retains all of its desirable brilliance while the varnish films made from it, having had their attackable or susceptible portions chemically acted on, do not weather, fissure, scale, etc. In this treatment under the present invention the acid groups are not attacked or affected and the resin retains its saponifiability, the treated resin being capable of combining with bases such as lime, zinc, oxid, lead oxid, etc., in the same way as the untreated resin. While for special purposes the treated resin may be so combined with bases, ordinarily I do not recommend it. The rise in melting point due to the treatment itself is generally sufficient to obviate any necessity for further hardening by the addition of bases; and such an addition may be undesirable as unduly raising the melting point as well as lowering unduly the solubility of the treated resin in the usual varnish solvents.

Formaldehyde is one highly reactive chemical suitable for my purposes. I have found that if I expose rosin to the vapors of formaldehyde under heat and pressure, the changes in the rosin which I desire readily take place. In one typical embodiment of my invention, for example, I heat rosin in any suitable container or vessel in the presence of formaldehyde vapors and advantageously also in the presence of steam. It is convenient to place commercial 40 per cent. formaldehyde solution in the treatment vessel with the rosin prior to heating and allow generation of vapors of formaldehyde and steam in the receptacle itself, but vapors may be generated elsewhere and led into the treatment vessel through a suitable conduit. While some degree of action will take place at lower temperatures and pressures, I find that a very desirable type of action obtains at high temperatures with pressures ranging from, say, 75 pounds to 150 pounds. As a rule I run the temperature between, say, 250° to 400° F., although 250° to 300° is generally best. Using formaldehyde vapors at any given temperature, the pressures are more or less irregular and vary up and down during the heating, possibly because of chemical actions taking place. The temperatures and pressures given however may be deemed exemplificatory of those well adapted for the present purposes. After the rosin has been hardened to the degree desired, it may be cooled and removed from the treating vessel in any convenient way. The time of treatment varies somewhat with the nature of the vessel used. Ordinarily, however, with formaldehyde the process requires two to six hours heating under pressure.

Steam *per se* does not have the effects here desired; but it is a useful adjunct to other materials in the present process.

Manila copal, gum dammar or Singapore copal, etc., may be treated in exactly the same manner as rosin. The rosin after its treatment retains much of its original aspect but its solubility in the cold in ordinary rosin solvents, such as methyl alcohol, gasolene, turpentine, etc., is greatly diminished. On the other hand, with such varnish solvents as hot linseed oil, it behaves much like the natural hard copals; the so-called fossil resins. In fact it may be said that the rosin appears to have undergone a change the results of which are similar to those which in nature have produced the fossil gums. Varnishes made from this hardened rosin have the brilliant appearance characteristic of those made from natural or untreated rosin, but they are much more permanent; not fissuring or cracking with age. In this respect, these varnish films resemble those made from the hard copals.

Similar characteristics obtained with dammar resin and the soft copals treated in the present manner.

Instead of using vapors of formaldehyde, which is a highly reactive body, other highly reactive bodies capable of readily uniting with organic substances may be used, such for example, as sulfur. I have found that I may obtain quite similar, but not identical, results by using, instead of formaldehyde solution, a suspension of sulfur in water. On heating with rosin under pressure vapors of sulfur and of water are produced and the sulfur vapors attack the alterable constituents of the resin. It is apparently mainly the vapors of the sulfur which perform the action here desired. Peroxid of hydrogen may be employed, the ordinary commercial aqueous solution of peroxid of hydrogen, for example, being placed in the treatment vessel in lieu of the stated formaldehyde solution. The peroxid however I do not find as good as the formaldehyde or the sulfur vapors.

The hardened resins hereinbefore described may be converted into varnish with any of the usual vehicles or solvents used for hard resins.

What I claim is:—

1. The process of treating soft natural resins which comprises heating the same under pressure with highly reactive vapors in the presence of water vapors.

2. The process of treating soft natural resins which comprises heating the same under pressure with formaldehyde vapors.

3. The process of treating rosin which comprises heating the same under pressure with highly reactive vapors in the presence of water vapors.

4. The process of treating rosin which comprises heating the same under pressure with formaldehyde vapors.

5. As a new composition of matter a hardened resin possessing the general properties of the corresponding soft natural resin but differing therefrom by being permanent on exposure to air and light and having a higher fusing point, such hardened resin having the reactive groups of the natural resin combined with formaldehyde.

6. As a new composition of matter hardened rosin possessing the general properties of the corresponding soft natural resin but differing therefrom by being permanent on exposure to air and light and having a higher fusing point, such hardened rosin having the reactive groups of the natural resin combined with formaldehyde.

In testimony whereof, I affix my signature.

FRANK S. LOW.

Patented Sept. 25, 1923. **1,468,960**

UNITED STATES PATENT OFFICE.

FRANK JOSEPH CRUPI, OF BROOKLYN, NEW YORK, ASSIGNOR TO HERMAN BEHR & CO., INC., OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

METHOD OF MAKING ABRASIVE ARTICLES OF MANUFACTURE AND PRODUCT.

No Drawing. Application filed September 22, 1922. Serial No. 589,942.

To all whom it may concern:

Be it known that I, Frank Joseph Crupi, a subject of the King of Italy, and resident of Brooklyn, in the county of Kings and State of New York, U. S. A., have invented certain new and useful Methods of Making Abrasive Articles of Manufacture and Product, of which the following is a specification.

This invention relates to a method of making abrasive articles of manufacture and product, such as abrasive sheets, discs, belts, wheels and the like, in which abrasive material is held on a backing of any suitable material. The backing is usually some appropriate fabric, such as paper or cloth or a combination of both, and for several years past there has been a growing demand for an abrasive material or cloth which is sufficiently waterproof to withstand disintegration when used on wet surfaces. This demand has become very extensive among finishers of painted or varnished surfaces where ordinary dry sandpapering is exceedingly unhealthful due to the poisonous nature of particles dislodged from the surfaces abraded. Many workmen who have inhaled such dust or other dislodged particles for considerable periods have suffered injuries and diseases of the lungs.

An object of my invention is to produce a waterproof abrasive article of manufacture adapted to withstand disintegration when used on wet surfaces, and constructed to hold both fine grade abrasive material and coarse grade abrasive material in place on the backing.

Heretofore, in using so called sandpapers, wetting of the abrasive and abraded surfaces has proved advantageous, not only because of the laying of the dust, but also because of the resultant effect of a better finish. However, ordinary sandpaper rapidly disintegrates when used on wet surfaces, and this disintegration of the material has always been objectionable. It is for these reasons that the extensive demand for waterproof sandpaper has arisen among sandpaper manufacturers, health bureaus and workmen.

For many years nothing could be found which was sufficiently waterproof and at the same time practical for holding both small and large grains of abrasives in place, though many attempts have been made so to do by the use of various compositions, comprising rubber, varnishes, gums, waxes, cellulose compounds, oils, etc.

So far as I am advised no composition has been found prior to my invention whereby the coarser grains of abrasive can be properly held in a waterproof abrasive manufacture. However excellent the results of the kind in question have been with finer grains of abrasive, it is still true that great numbers of workmen who require coarse grain sandpapers are unprovided with waterproof, coarse grain sandpapers, for which the demand is insistent.

In the attempt to solve the serious and difficult problem above indicated, I have covered a wide field of research and made great numbers of experiments which have resulted in fine and coarse grain waterproof sandpapers that have been subjected to actual uses under working conditions and appear to solve the problem.

I have, prior to this invention, invented and used a flexible, water-resisting cement for the purpose of holding abrasives in place on backings, and made in accordance with the following formula:

Rosin________________	about	250	lbs.	avoirdupois
Glue ______________	"	50	"	"
87% phenol (carbolic acid) ___________	"	100	"	"
33% acetic acid_____	"	200	"	"

In continuation of the work done under the above formula, I have constantly borne in mind the practical requirements of the art; that the product in question should be waterproof, cheap, tough and flexible, and preferably capable of being used with present manufacturing equipments. And I have recognized the difficulty with most compositions proposed in the prior art,—that while some of them were waterproof they lacked flexibility and toughness, and therefore could not hold the abrasive, while others were very tough and flexible but lacked the requisite waterproof qualities and therefore rapidly disintegrated in use.

I note now that the rosin element of my above and under mentioned formulæ is a practically perfect waterproof substance, but lacks toughness and flexibility, and that glue, on the other hand, possesses flexibility and toughness, but is not waterproof.

The formula which I now use, and which has been developed on study and experiment relating to the chemical, theoretical and colloidal characteristics involved, is—

Rosin	250	lbs. avoirdupois
87% phenol (carbolic acid)	75	" "
Glue	60	" "
Water	100	" "
56% acetic acid	100	" "
Benzine or benzene	5	" "

In preparing the above compositions the full quantity of rosin in powdered form is placed in a copper tank which is jacketed and equipped with a heating device. The phenol is then poured into the rosin and mixed well with it, the rosin being soluble in phenol. After allowing the phenol and rosin to soak for a short time, the heat is turned on in order to dissolve the rosin thoroughly, whereupon both ingredients react to form a rosin ester, in which case the rosin probably acts like an acid and the phenol like an alcohol. This solution will absorb a limited amount of water.

In a separate container, I prepare a solution of glue, which is preferably hide glue, with the water and acetic acid specified in the formula. The glue is easily dissolved in the acetic acid and water volume by the aid of a little heat, and when so dissolved is poured into the solution of phenol and rosin, accompanied by constant and rapid stirring. The glue, acetic acid and water solution mixes with the rosin and phenol solution and upon coming in contact with the excess of phenol, over and above the phenol required to unite with the rosin, the glue is immediately reacted upon by the phenol and would coagulate were it not for the excess of the acids present which tend to reverse or prevent the coagulation. This combined mixture of the rosin solution and of the glue, water and acetic acid solution is insoluble to some extent in water, but it will absorb a limited amount of water and thicken very heavily, due to hydration of the colloids.

The carbolic acid in the mixture serves to reduce the surface tension between the glue and the rosin and causes a more thorough intermixture or emulsion of the whole colloidal system.

Now a solution of rosin, glue and phenol alone if spread on paper would take a long time to dry, and is not entirely satisfactory for application on backings.

It is desirable to use the least amount of phenol that is practicable because an unnecessary excess only serves as a detriment to drying and is, moreover, undesirably expensive. Consequently, in economic practice, it is actually a heavy or thick mixture that is formed, and such mixture requires a diluent.

I find that water is very objectionable as a diluent in this case because it thickens or raises the viscosity and also so affects the surface tension condition of the colloidal system as to impair its waterproof qualities. And I have found that I can use acetic acid having a water content as a diluent because the presence of this acid tends to improve the surface tension condition and to keep the glue from jellying while it is being spread.

As the colloidal system exists now in this mixture of rosin, glue, phenol, acetic acid, and water, the union or intermixture of both phases, water-soluble and water-insoluble, is quite homogeneous and could be used with satisfaction, but I have found that the addition of a small amount of benzine (5 lbs.) still further improves the composition, in that it increases its waterproof qualities without appreciably diminishing the toughness and flexibility. This is due to the following change in the colloidal system.

Without the benzine, the water-insoluble phase, that is the rosin phase, is more the dispersed phase than the water-soluble phase, that is the glue phase, so that there exists in the colloidal solution particles of glue and particles of rosin minutely subdivided and intermixed. The glue particles, for the greater part, form the continuous phase and envelop the rosin particles. The greater the extent to which this condition is brought about, which can be done by adding excessive amounts of the water-soluble phase, or anything which will lower the surface tension of the water-soluble phase, the tougher or stronger the dried layer of the solution will be but the lower in waterproof qualities. If, on the other hand, the surface tension relations are raised, which can be done by adding excessive amounts of the water-insoluble phase or benzine, the condition will be reversed, i. e., the rosin particles, on account of the presence of the benzine, gain the upper hand and envelop the glue particles, the colloidal system then forming particles of glue as the dispersed phase surrounded by particles of rosin as the contiuous phase.

The resulting solution, when dry, is very waterproof, but not tough or flexible. So, briefly, it seems that when the glue phase predominates it envelopes the rosin particles and naturally the glue being able to unite thoroughly throughout would dry very strong, but being exposed, since the rosin particles are on the inside, it is not very waterproof; and vice versa when the rosin phase predominates.

In order to bring about the most homogeneous distribution of both phases, I have found that only a small amount of benzine such as I use in my formula, will, in this composition, serve beneficially to that end, the resulting product being a colloidal system homogeneous throughout with about as many glue particles surrounding rosin particles as rosin particles surrounding glue particles; and the result is waterproof, tough and flexible qualities.

To return to the acetic acid again, were I to eliminate it, or eliminate it beyond a limited extent, I would be confronted with the following phenomena. The solution upon being applied on the paper would immediately jell, which fact would cause an aggregation of the minute colloidal particles. In this stiffened condition, the mere force of spreading would break the globules open so to speak. These would immediately set and harden in that condition without any of the beneficial colloidal homogeneity properties functioning.

The presence of acetic acid, on the other hand, keeps the solution fluid and homogeneous throughout, so that after the force exerted on the mass in spreading it has been removed, the solution will regain its original characteristics and dry accordingly. Therefore, it is obvious that each and every one of my ingredients has a specified importance in this composition.

To conclude, the whole solution as I have formulated and described it, is very stable and can be used at any time after being prepared. It will retain its chemical and physical properties, being a fluid while hot and a jelly when cold.

This solution as it is, can be used alone and be quite satisfactory, but I have found that a formaldehyde treatment, and finally a very thin coat of linseed oil will improve the qualities of the finished product considerably.

The process of manufacturing the waterproof paper, which I have found to be entirely successful, is as follows:

It has been found in the manual use of a waterproof abrasive paper on wet surfaces, that the back needs to be waterproof as well as the front, since the paper upon becoming wet will wear through very easily, due to the friction of the hand or fingers on the back of the paper with which it was being held. Therefore, the back of the paper is primarily coated with any cheap waterproofing compound that when wet will resist the pressure and friction of the fingers. For this purpose I have utilized a well-known reaction of glue with formaldehyde. This is done as follows:

The paper is passed through a coating-machine, which applies a coating of glue solution. While the glue on the paper is not yet entirely dry it is treated with a diluted solution of formaldehyde. This formaldehyde combines with the glue and the resulting dry layer forms a water-insoluble protection for the backing of the paper.

On account of its strength, and flexibility and convenience of making, I would rather use such material than wax, oil or varnish compositions.

After the back of the paper is so treated, it is passed through a coating-machine where it receives the usual coating of glue. Immediately following, is sprinkled into the layer of glue which is yet warm and plastic, the usual coating of abrasive material. The paper then travels along racks into a sizing machine. Here, instead of being sized with ordinary glue solution, it is sized with said waterproofing solution which is immediately sprayed with a diluted formaldehyde solution.

The water-resistant composition enters the interspaces between the abrasive grains and its solvent action on glue causes it to unite with the underlying glue coat which primarily held the abrasive grains in place; and the united water-resistant composition and glue set as a tough, flexible, water-resistant binder or bond which holds the abrasive grains in place.

The purpose and advantage of spraying this water-resistant composition with a solution of formaldehyde are as follows:

The composition consists of two collodial phases—the rosin phase and the glue phase. It is to be remembered that there exist glue particles which are exposed although not freely exposed. I have found that a piece of sandpaper made with this composition, but without the formaldehyde treatment, although it will last to a certain degree of satisfaction, the glue phase being not as water-resisting as the rosin phase, will begin to wear out under the strain of the friction and water. Such removal of the glue particles leaves an open framework or a porous structure of rosin particles, which alone cannot stand the further tension of friction, and rapidly disintegrate. So it being known that formaldehyde renders glue insoluble although not impervious, I thought of the following treatment which overcomes this condition. Although the glue particles of the solution are perhaps softened due to a slight absorption of water, still they do not dissolve or wear out very easily, and consequently the whole waterproof structure is able to retain its lasting qualities.

Another advantage of this formaldehyde treatment is that upon immediately spraying or treating otherwise my waterproofing composition with formaldehyde, the formaldehyde quickly reacts on the glue phase of the collodial composition and sets it or stiffens it so that it imprisons some of the solvents and retards their evaporation, thus imparting a degree of flexibility to the finished product.

After the application of this waterproofing composition, and the formaldehyde treatment, the product is dried. After drying it is given a final sizing of a ten percent solution of boiled linseed oil in benzine. This is a very thin film which serves beneficially in that it strengthens the rosin or water-insoluble phase of the composition on the surface of the dried layer, and serves as an extra protection for the underlying basic waterproof and tough composition that holds the abrasive elements in place.

The product is then again dried and is ready to be used, the resulting product being a satisfactory, waterproof sandpaper possessing all the necessary qualities and being practically the first of its kind, and the only one yet made, so far as known, which fills all requirements of the trade.

It will be observed that the actual water content of each of the two formulas above specified is very nearly alike.

The product smells of carbolic acid and if the benzine and linseed oil solution is used as a final sizing, the product is further characterized by an oil film, in addition, of course, to solids.

What I claim is:

1. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water in about the proportions stated, and in which the acids prevent coagulation of the glue.

2. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water in about the proportions stated, and in which the acids prevent coagulation of the glue; and in spraying the so formed abrasive surface of the web with a formaldehyde solution.

3. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water in about the proportions stated, and in which the acids prevent coagulation of the glue; and in spraying the so formed abrasive surface of the web with a formaldehyde solution; and in drying the web thus treated and then sizing the abrasive surface with a solution of boiled linseed oil in benzine.

4. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue which primarily holds the abrasive material in place; in applying abrasive material to the glue coating; in sizing the glue and abrasive coating with a compound of rosin, glue, an acid having a water content and benzine.

5. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue which primarily holds the abrasive material in place; in applying abrasive material to the glue coating; in sizing the glue and abrasive coating with a compound of rosin, glue, an acid having a water content and benzine; and in coating the surface thus formed with formaldehyde.

6. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue which primarily holds the abrasive material in place; in applying abrasive material to the glue coating; in sizing the glue and abrasive coating with a compound of rosin, glue, an acid having a water content and benzine; and in coating the surface thus formed with a 10% solution of boiled linseed oil in benzine.

7. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water in about the proportions stated, and in which the acids prevent coagulation of the glue and the acetic acid and phenol act as a solvent of the underlying glue for bonding the composition thereto, and in which glue particles are caused to be surrounded by rosin particles and rosin particles are caused to be surrounded by glue particles; and in coating such surface with an oil film.

8. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water in about the proportions stated, and in which the acids prevent coagulation of the glue; and in applying a glue coating to the back of the backing and while such glue coating is moist in sizing the same with a formaldehyde solution.

9. As a new article of manufacture for subsequent use when dry a backing coated with a solution of glue and abrasive ma-

terial; over the glue and abrasive material a coating containing rosin, glue, phenol, acetic acid and water, and in which the acids prevent coagulation of the glue and the acetic acid and phenol act as a solvent of the underlying glue for bonding the composition thereto.

10. As a new article of manufacture, a backing provided on one surface with a coating of glue, a layer of abrasive material on the glue and on the abrasive surface a coating comprising rosin, glue and an acid content and in which the composition is bonded to the underlying glue that holds the abrasive material.

11. As a new article of manufacture, a backing provided on one surface with a coating of glue, a layer of abrasive material on the glue and on the abrasive surface a coating comprising rosin, glue and an acid content and in which the composition is bonded to the underlying glue that holds the abrasive material; and over the composition coating an oil film.

12. The herein described method of making abrasive manufactures consisting in coating a backing with a solution of glue; in applying abrasive material to the glue coating; in coating the glue and abrasive coating with a colloidal, waterproof, adhesive composition containing rosin, glue, phenol, acetic acid and water and benzine in about the proportions stated, and in which the acids prevent coagulation of the glue; and in spraying the so formed abrasive surface of the web with a formaldehyde solution; and in coating the same with oil.

Signed at New York city in the county of New York and State of New York this 15 day of September A. D. 1922.

FRANK JOSEPH CRUPI.

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Patented June 22, 1926. 1,590,079

UNITED STATES PATENT OFFICE.

LAWRENCE C. BYCK, OF TOTTENVILLE, NEW YORK, ASSIGNOR TO BAKELITE CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

POTENTIALLY REACTIVE LIQUID-COATING COMPOSITION.

No Drawing. Application filed November 5, 1923. Serial No. 673,017.

This invention relates to liquid coating-compositions such as varnishes, impregnating solutions, lacquers and the like, containing a phenolic resin and a modifying or plasticizing agent. The present application is a continuation in part of my prior and co-pending application Serial No. 590,943, filed September 27, 1922.

In said application, I have pointed out that by mixing and properly reacting a suitable phenolic body, such as phenol or cresol, with certain fatty oils, and specifically with tung oil, in presence of small proportions of so-called "converting agents" of which aluminum chlorid and phosphoric acid may be regarded as types, I obtain a viscous fluid product which does not possess the characteristic odor of tung oil, and which I now regard as a combination of the oil, or some conversion product thereof, with the phenol; the term "combination" being here used in its broad sense to indicate some physical, chemical or physico-chemical association or union, the nature of which is at present unknown. According to the preferred embodiment of the invention, as described in the said prior application, I react upon this viscous product, either in presence or absence of water, with a hardening agent having a mobile methylene group, as for instance formaldehyde, trioxymethylene, hexamethylenetetramine, etc., the hardening agent proportioned to the phenol to yield a resin of the so-called permanently soluble and fusible or non-reactive type. The resulting non-reactive composition may be rendered potentially reactive by the addition of suitable further proportions of the same or other methylene-containing hardening agents. The expression "potentially reactive" is well understood in this art as indicating that the product (resin, molding mixture, varnish film, impregnation residue, etc.) may by sufficient application of heat be transformed to a hard and infusible or so-called resinoid state. While I prefer to proceed as described above in two stages, producing first a non-reactive condensation product, that is to say, a resin which does not undergo the above described transformation by simple application of moderate heat, and thereafter rendering the same potentially reactive by suitable methylene additions, it is within the scope of my invention to add sufficient methylene containing hardening agent in the first instance to impart to the composition the desired potentially reactive character. This latter procedure is however decidedly more difficult to control.

In order that the present invention may be fully understood I will now give an illustrative example of the application of the same to the preparation of a varnish or impregnating solution, it being understood that the conditions and proportions stated are illustrative only, and will be varied according to the particular technical effect desired.

I first prepare a mixture of a suitable phenolic body such as phenol or cresol, a vegetable oil, such as tung oil, and the converting agent. The proportions used as well as the materials selected will depend upon the particular results sought. Smaller proportions of the oil, such as 20–30 parts of tung oil to 100 parts of phenol, yield a hard and substantially non-plastic final product, although the plasticizing effect of the oil addition is strongly marked in the product before the final hardening. When decidedly larger proportions of oil are used the ultimate product or varnish film is correspondingly plasticized; and in the case where tung oil is introduced into the original mixture in larger amount, preferably upward of about 75% of the phenol by weight, the subsequent operations being properly performed, the final film, although infusible and resistant to most chemical agents, is highly flexible. For the preparation of such flexible films I proceed as follows:

A typical mixture may comprise phenol, 100 parts; tung oil, 140–150 parts; phosphoric acid, 1–2 parts. The mixture is heated to boiling under a reflux condenser for one half to six hours. The viscosity of the product will be greater as the heating is longer, and the consistency as well as certain other properties of the varnish may be varied at will by a careful control of this heating stage. The same results may be obtained by more prolonged heating at lower temperatures; but such prolonged action or such high proportion of converting agent as will result in the solidification of the mixture must be avoided. The product is liquid at ordinary and higher temperatures, more or less viscous according to the reacting conditions, dark brown in color, transparent in thin layers, and possesses a characteristic odor which does not resemble that of tung oil. Some free phenol can be identified in the product but there is no indication that tung oil, either polymerized or unpolymerized, is present therein to any substantial extent. For convenience I will refer to this product as the phenol-oil composition. When prepared as described above it contains a relatively small proportion of the original phenol in free or uncombined condition, removable by vacuum distillation or by extraction by means of cold caustic alkali. I have not been able to identify or to isolate uncombined tung oil.

To this phenol-oil composition I add 5–14 parts by weight of dry hexamethylenetetramine, and heat rapidly with stirring until the evolution of ammonia ceases. The use of substantially larger proportions of hexamethylenetetramine should be avoided at this stage as tending to give a resin of the infusible type. With the limited proportions mentioned the product is a non-reactive resin in the sense that it cannot be hardened by simple application of heat, although it may gelatinize at high temperatures. It is permanently fusible, in the sense that it can be maintained indefinitely in fusion at temperatures only slightly above its melting point. For convenience I will refer to this product as the non-reactive phenol-oil-methylene resin. Its characteristics of course vary according to the conditions of its preparation. Made as above it is after cooling a dark brown, transparent resinous body, the hardness of which depends largely upon the length of the heating in the preparation of the phenol-oil composition. It is usually brittle when thoroughly cold, and rather rubbery at higher temperatures. It may flow slowly at room or summer temperatures. It is freely soluble in turpentine and mixtures of turpentine and benzol; partially soluble in benzol, alcohol and acetone; soluble in mixtures of benzol with alcohol or acetone. It may be used in this non-reactive state as a varnish base for applications where infusibility and insolubility in the final film are not important; but I prefer to impart to it a potentially reactive character. My preferred method of accomplishing this is as follows:

The non-reactive phenol-oil-methylene resin is dissolved while hot in any desired solvent, for example turpentine, using for example 125–175 parts of turpentine to each 100 parts by weight of phenol in the original mixture. The solution is cooled to about 100°–110° C. and 6–14 parts of dry hexamethylenetetramine (for each 100 parts of phenol in the original mixture) added with stirring. In a typical case the quantity of additional hexamethylenetetramine added at this stage is such that the total methylenes present will correspond approximately to 20 parts of hexamethylenetetramine to each 100 parts by weight or phenol originally used. The solution is then heated slowly to about 125°–135° to effect a partial reaction only of the hexamethylenetetramine. The effect of this is to stabilize the solution and to avoid the separation of small quantities of a crystalline substance, which otherwise may occur at times. The resulting varnish may be thinned as desired with benzol or other appropriate solvent and is ready for use. When it is desired to prepare a lacquer the usual lacquer solvents, amyl acetate, amyl alcohol, etc. are added.

Varnishes and lacquers prepared as above may be applied to wood, metal, fabrics, paper and all other bases, and yield when baked (preferably at about 160°–170° C.) lustrous, adherent, mechanically and chemically resistant, electrically insulating and highly flexible films. They have been found well suited, among other uses, for the manufacture of so-called composite cardboard, or laminated products (U. S. Patent #1,019,406 to L. H. Baekeland) comprising sheets of paper, canvas, etc. coated or impregnated with the phenolic condensation product, and consolidated and transformed by sufficient application of heat.

Varnishes similar in type but differing among themselves in their specific characteristics have been prepared by this process from a wide variety of fatty oils, including drying oils such as tung and linseed, semidrying oils as soya bean and fish-oils, and miscellaneous or non-drying oils, as perilla, castor and rape-seed. As will be readily understood the details of the process, including the proportions of the reagents, the time and temperature of heating, etc. will be varied in accordance with the particular technical effects to be obtained as well as with the particular oils chosen. All of these oils are capable, under properly controlled conditions, of yielding excellent varnish films; but so far as my investigations have gone, the films from the compositions prepared with tung oil exhibit by far the highest degree of flexibility.

The invention is not restricted to the employment of any particular converting agent, but whatever converting agent is used it is preferably employed in such small proportions (not exceeding 3% by weight of the phenol, and usually much less than this) that it will be unnecessary to eliminate it by washing. Washing the phenol-oil composition removes uncombined phenol, disturbes the reacting proportions, and tends to irregularities and uncertainties in the final product. Among the converting agents which I have successfully used I may mention anhydrous aluminum chlorid, sulfur chlorid, sulfur antimony sulfids, anhydrous hydrochloric acid, phosphoric acid and anhydride, concentrated surfuric acid, oxalic acid, pyrogallol and acetic anhydrid. Many other substances, both inorganic and organic, are capable of the same or similar action.

I claim:

1. A potentially reactive liquid coating-composition comprising a non-reactive phenol-oil-methylene resin, a methylene-containing hardening agent therefor, and a solvent for said components.

2. A potentially reactive liquid coating-composition comprising a non-reactive phenol-tung oil-methylene resin, a methylene containing hardening agent therefor, and a solvent for said components.

3. Process of making a liquid coating-composition comprising commingling a phenol, a fatty oil, and a converting agent, the converting agent not in excess of 3% by weight of the phenol; reacting said materials until a viscous product results; and adding thereto a solvent, and a methylene-containing hardening agent in proportion to impart to the composition a potentially reactive character.

4. Process of making a liquid coating-composition comprising commingling a phenol, tung oil, and a converting agent, the converting agent not in excess of 3% by weight of the phenol; reacting said materials until a viscous product results; and adding thereto a solvent, and a methylene-containing hardening agent in proportion to impart to the composition a potentially reactive character.

5. Process of making a liquid coating-composition comprising commingling a phenol, a fatty oil, and a converting agent, the converting agent not in excess of 3% by weight of the phenol; reacting said materials until a viscous product results; and adding thereto a solvent, and a methylene-containing hardening agent in proportion to impart to the composition a potentially reactive character and stabilizing the composition by application of heat.

6. Process of making a liquid coating-composition comprising commingling a phenol, tung oil, and a converting agent, the converting agent not in excess of 3% by weight of the phenol; reacting said materials until a viscous product results; and adding thereto a solvent, and a methylene-containing hardening agent in proportion to impart to the composition a potentially reactive character and stabilizing the composition by application of heat.

7. Process of making a potentially reactive liquid coating-composition comprising commingling a phenol, a fatty oil, and a converting agent, reacting said products until a viscous phenol-oil-composition results; adding a methylene-containing hardening agent in proportion to yield a non-reactive phenol resin and reacting the same; and thereafter incorporating a solvent and such further amount of methylene-containing hardening agent as will impart to the product a potentially reactive character.

8. Process of making a potentially reactive liquid coating-composition comprising commingling a phenol, tung oil, and a converting agent; reacting said products until a viscous phenol-oil composition results; adding a methylene-containing hardening agent in proportion to yield a non-reactive phenol resin and reacting the same; and thereafter incorporating a solvent and such further amount of methylene-containing hardening agent as will impart to the product a potentially reactive character.

In testimony whereof, I affix my signature.

LAWRENCE C. BYCK.

Patented July 13, 1926. **1,591,999**

UNITED STATES PATENT OFFICE.

LAWRENCE V. REDMAN, OF CALDWELL, NEW JERSEY, ASSIGNOR TO BAKELITE CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

LIQUID COATING COMPOSITION.

No Drawing. Application filed October 11, 1922, Serial No. 593,908. Renewed October 25, 1924.

This invention relates to compositions, and more particularly to coating compositions, containing resins of the phenolic condensation product type; and comprises a liquid coating composition containing such resin, an aqueous alkaline solvent therefor, and an aldehyde (or equivalent body having aldehyde functions) which is of lower reactivity than formaldehyde or hexamethylenetetramine, and which is capable of functioning both as a diluent for the alkaline solution and as a hardening agent for the resin. The aldehyde body which I preferably employ is furfural, either alone or in conjunction with other aldehydes or aldehyde-derivatives such as formaldehyde, hexamethylenetetramine, acetaldehyde or paracetaldehyde, and the like: but other aldehydes or aldehyde-derivatives which resemble furfural in respect to having a materially lower degree of reactivity toward the phenolic resins than formaldehyde may be substituted for furfural without departure from my invention. For example, butylaldehyde may be so employed.

It is known, in accordance with United States Patent 1,085,100, granted January 27, 1914, to L. H. Baekeland, that phenolic resins, of either the reactive or non-reactive type, may be dissolved in water containing the minimum proportion of alkali hydroxid requisite for the preparation of a stable solution; and that the solutions so prepared are available for many uses in the arts, being employed for example as coating compositions; for the impregnation of porous materials such as cement, stone, wood, paper, fabrics and the like; or for compounding molding mixtures. As compared with solutions of the same resins in alcohol and other organic solvents, these resins derived from aqueous alkaline solutions are decidedly more reactive, undergoing the transformation to the infusible state in a shorter time and also at a lower temperature. As is now well understood in this art, this transformation is brought about by the agency of so-called "hardening agents" which usually comprise a mobile methylene group (either substituted or not), and include formaldehyde and its polymers, formaldehyde derivatives of the methylene-amin type, as well as other aldehydes of higher molecular weight, such as acetaldehyde, benzaldehyde, and furfuraldehyde (furfural), which contain substituted methylene groups and behave similarly to formaldehyde in this reaction. As is also well understood, and as explained in the Baekeland patent above mentioned, the hardening agent may be incorporated in sufficient proportion with the phenolic body to yield directly a reactive resin, that is to say a resin which is capable of transformation by simple heating to the infusible final product: or it may be incorporated in such lesser proportion as will yield as the first reaction product a phenolic resin of the non-reactive or permanently soluble and fusible type; which resin, after being freed from any undesired excess of free phenol, may be admixed with the requisite amount of a hardening agent, and converted thereby into a potentially reactive resin, essentially similar to that prepared by the direct or single-step method first above mentioned.

The potentially reactive resins in aqueous alkaline solution, whether prepared by the single-step or double-step method, are rather viscous, and consequently possess a relatively low penetrating power. This limits their application to some extent, particularly for the manufacture of laminated products, composite cardboard and the like, where highly penetrative solutions are often desired. Moreover the very high reactivity of these resins is often a drawback in this particular application, especially when the resin is applied to the paper or fabric in powder form, and the coated sheets are superposed and consolidated by heat and pressure. In this case a slowly reacting resin is desirable, as affording time after fusing and before attaining the infusible stage, for a satisfactory penetration of the paper, fabric or other fibrous base.

For all such applications, and for other applications in this art, it is desirable to provide a potentially reactive resin in an aqueous solution of relatively low viscosity and high penetrating or impregnating capacity, the resin being also preferably less reactive than those prepared in accordance with Patent 1,085,100 above mentioned. I have discovered that these several advantages may be attained by the use as a hardening agent for the phenolic resin of furfuraldehyde (furfural). This substance, which has recently become available in considerable quantity, is an excellent solvent for the non-reactive resin; and by virtue of its aldehyde character is of course capable of serving as a hardening agent therefor. It is moreover soluble in or miscible with water, and also with the aqueous alkaline solutions of the resin. While its hardening action on the phenolic resins is essentially similar to that of formaldehyde, it is decidedly less reactive or more slowly reactive than this substance, which as already stated is a desirable characteristic in certain applications in which it is desired that the potentially reactive composition should remain for appreciable periods in the fused state before undergoing the reaction which yields the ultimate hard and infusible condensation product. The furfural is not merely a diluent for these aqueous alkaline solutions, but in addition to counteracting the viscosity of the solutions and increasing their penetrating power, it imparts to them an excellent flowing quality, which is of great importance in the covering of either porous or non-porous surfaces. Moreover as already explained, it is capable of functioning as a hardening agent in the final transformation.

The following is a typical procedure in accordance with this invention, it being understood that the invention is not restricted to the proportions or manipulations as therein set forth:

I first prepare a phenolic resin of the non-reactive, or permanently fusible soluble type, by any of the known methods, such for example as by reacting upon phenol with hexamethylenetetramine in the approximate proportions of 7.5 mols. of phenol to 6 mols. of active methylene, the latter being added as hexamethylenetetramine or any equivalent body, such as a reactive aldehyde. The resulting resin may be subjected to the usual treatment for the elimination of excess phenol, and is dissolved in an alkaline solution, preferably water containing about 5 percent of caustic soda. One pound of resin to about two pounds of the caustic soda solution is a satisfactory proportion. I then dilute the solution by the addition of furfural, introducing in a typical case about 3.5 mols. of furfural for each 7.5 mols. of phenol in the original resin, thereby obtaining a potentially reactive composition contaning about 9.5 active methylenes to 7.5 mols. phenol. By "potentionally reactive composition" a term now well understood by those familiar with this art, I designate such phenolic condensation products as are initially fusible and soluble but are transformable by simple heating for a sufficient time and at an appropriate temperature into a hard and infusible body. The resulting solution is ready for use in any of the manifold ways now familiar to those skilled in this art. Its penetrative and flowing qualities, in conjunction with its relatively slow reaction rate, render it especially suitable for the manufacture of composite cardboard in accordance with the Baekeland Patent 1,019,406 of March 5, 1912. For this application the sheets of paper or fabric are coated or impregnated with the solution, and are permitted to dry, advantageously in a current of air at room temperature, avoiding in any case such heating as will prematurely transform the resin. The coated or impregnated sheets are then superposed and consolidated in a press with steam heated platens in the manner now well understood in the art.

A modification of the above procedure is to dry the sheets in a current of air containing some carbon dioxid. Thereby the sodium present as hydroxid or phenolate is transformed to carbonate, which although not a solvent for the resin is equally effective as the hydroxid in the final hardening. It is to be noted that in this modification the alkali is retained in the non-carbonated state as long as its solvent action upon the resin is required,—that is to say until the solution has been spread or otherwise employed according to the particular application in view; and is then converted into the carbonate, as a step preliminary to the transformation of the resin into its hard and infusible form.

In the illustrative example given above the furfural is employed as the sole hardening agent, and is used in the proper molecular proportion to the phenol to accomplish this result. It is within my invention, however, to substitute any proportion of the furfural by equivalent hardening agents of the aldehyde type, as formaldehyde, hexamethylenetetramine or the like, the effect of such substitution being to increase correspondingly and progressively the reactivity of the composition. Or alternatively I may provide sufficient hexamethylenetetramine or its equivalents to accomplish the hardening, while adding the furfural simply as a diluent for the solution and for its plasticizing effect on the final product. Or as already explained, I may replace the furfural by other bodies possessing the necessary aldehyde character, but characterized by a higher molecular weight than formaldehyde and a relatively low degree of reactivity toward the phenolic resin.

I claim:—

1. A potentially reactive liquid coating composition comprising a phenolic resin, an aqueous alkaline solvent therefor, and an aldehyde body capable of functioning both as a diluent for the solution and as a hardening agent for the resin.

2. A potentially reactive liquid coating composition comprising a phenolic resin, an aqueous alkaline solvent therefor, and a

hardening agent for said resin, said hardening agent having a materially lower degree of reactivity than formaldehyde.

3. A potentially reactive liquid coating composition comprising a phenolic resin, an aqueous alkaline solvent therefor, and a hardening agent for said resin, said hardening agent comprising an aldehyde of higher molecular weight than formaldehyde and a materially lower degree of reactivity.

4. A potentially reactive liquid coating composition comprising a phenolic resin, an aqueous alkaline solvent therefor, and furfural.

5. A potentially reactive liquid coating composition comprising a phenolic resin, an aqueous alkaline solvent therefor, furfural and another methylene-containing hardening agent.

6. A liquid coating composition containing a phenolic condensation product which is capable of transformation by heat into an infusible body, and a solvent comprising aqueous alkali and furfural.

In testimony whereof, I affix my signature.

LAWRENCE V. REDMAN.

April 26, 1927. | H. C. MARTIN | 1,626,246

ARTICLE OF BONDED GRANULAR MATERIAL AND METHOD OF MAKING THE SAME

Filed Nov. 13, 1924

Fig. 1.

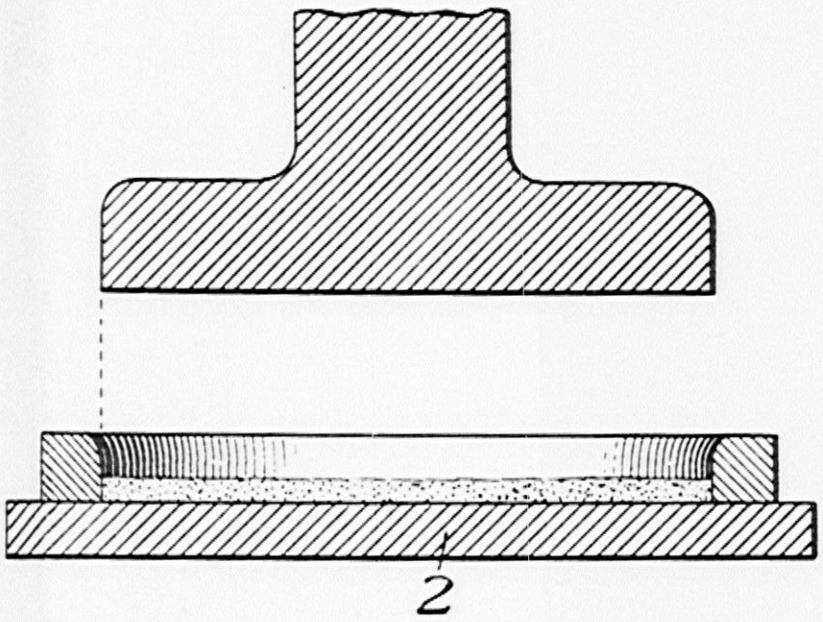


Fig. 2.

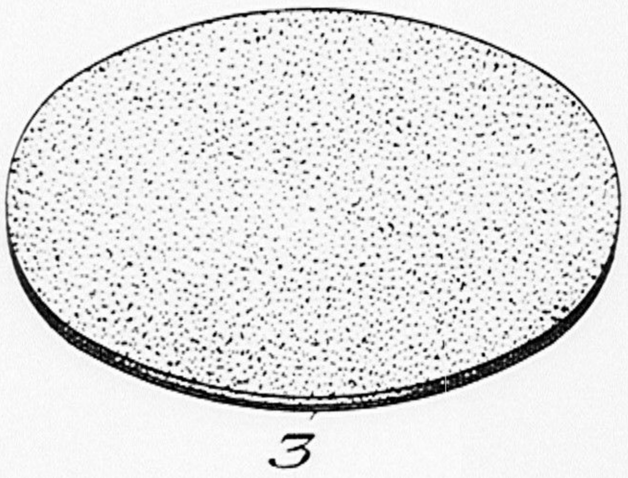
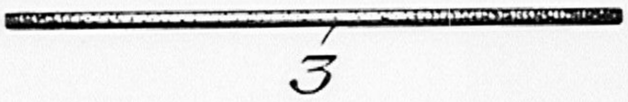


Fig. 3.



INVENTOR

Harry C. Martin

By Byrnes, Stebbins & Parmelee

His Attys

REISSUED

Patented Apr. 26, 1927. **1,626,246**

UNITED STATES PATENT OFFICE.

HARRY C. MARTIN, OF NIAGARA FALLS, NEW YORK, ASSIGNOR TO THE CARBORUNDUM COMPANY, OF NIAGARA FALLS, NEW YORK, A CORPORATION OF PENNSYLVANIA.

ARTICLE OF BONDED GRANULAR MATERIAL AND METHOD OF MAKING THE SAME.

Application filed November 13, 1924. Serial No. 749,773.

The present invention relates to articles of bonded granular material and their process of manufacture, this application being a continuation in part of my co-pending application, Serial No. 690,766, filed February 5, 1924.

While this invention is applicable to various articles of bonded granular material, it will first be described with particular reference to its embodiment in abrasive disks of the type used on machines known as disk grinders for the grinding of flat surfaces on metals and other materials. These disks must have a relatively high degree of porosity to prevent glazing and hence the proportion of the binder with respect to that of the abrasive grains is limited and the amount of agglomerating pressure is also limited. It is important, therefore, that the bond between the abrasive grains possess a high degree of mechanical strength. Such disks usually consists of a paper or cloth backing or body coated with a layer of abrasive material bound to the backing by means of glue after the manner of ordinary sand paper and emery cloth. Their use is limited, due to the fact that when using a glue binder, the coating must be relatively thin and the disks do not, therefore, possess very much durability when called upon to do heavy work or remove large quantities of metal.

I have discovered that a very efficient disk of superior quality can be made by the use of a mixture of abrasive grains and a synthetic resin such as a phenol resin. The phenol resin which I prefer to employ is known under the trade name of redmanol. Redmanol is a synthetic resin which consists of a phenolic body mixed with a hardener. This hardener is a formaldehyde compound such as hexamethylenetetramine. I prefer to use the redmanol in a powdered form.

In the accompanying drawings, forming part of this specification,

Figure 1 is a sectional view of a suitable mold which may be employed in the manufacture of the disks;

Figure 2 is a perspective view of a finished disk, and

Figure 3 is an edge view of the disk shown in Figure 2.

In the manufacture of disks in accordance with my invention, I prefer to proceed as follows: I first take graded abrasive grains of the proper size or grit for the work to be ground, and add a sufficient quantity of a resin solvent to coat the surface of the grains. I prefer to employ furfural as the coating solvent, using this substance in the proportion of approximately 30 cubic centimeters thereof to 1000 grams of grains if the latter are of medium size or grit. For abrasive grains of the finer grade, however, the amount of the solvent employed may be as low as 25 cubic centimeters per 1000 grams of grains, while it may run as high as 40 cubic centimeters per 1000 grams of grains of the coarser grade. Furfural is an aldehyde which has the property of acting with the hexamethylenetetramine constituent of the redmanol to form also a resin of a character similar to redmanol resin. Having moistened the abrasive grains with a sufficient quantity of the solvent to coat all of their surfaces, I then mix redmanol in powdered form therewith. If the abrasive grains are of medium size or grit, a sufficient quantity of redmanol will be added to constitute approximately 10 per cent by weight of the mixture. The redmanol may, however, constitute from 7 to 15 per cent of the mixture, depending upon the grade of the abrasive grains, the finer grits requiring more of the resin than the coarser grits. When the resin is thus added to the moistened grains, the furfural dissolves enough resin to coat the grains uniformly over their surfaces with the solution of furfural and resin. The furfural also tends to carry the dissolved binder into the pores of the grains. In this way a good bond is obtained between the grains and binder, even with a comparatively dry mixture. The ingredients are mixed quickly to keep the mass from balling up, and they form a mass of quite dry consistency which can be readily spread in thin layers of great uniformity. This is not possible with wet mixtures.

After this mixture is thoroughly incorporated, it is placed in an iron mold of the shape required for the disk, such as is shown in Figure 1, evenly spread over the bottom plate 2 of the mold, and molded under a pressure of approximately 900 pounds to the square inch. The material is then removed from the mold and baked in an oven for 15 hours at a temperature of about 350 degrees F. The next step is to mount the disk on portion being formed from a substantially dry, compressed and baked mixture comprising abrasive grains moistened with furfural, and a phenol resin, substantially as described.

10. An abrasive article comprising a molded and baked mixture of abrasive grains moistened with furfural, and a phenol resin, the phenol resin constituting between 7 and 15 per cent by weight of the mixture, substantially as described.

11. The method of making abrasive articles which comprises moistening the surfaces of the grains with furfural, mixing the moistened grains with a phenol resin binder, molding the mixture under pressure, and then heating it sufficiently to harden the binder, substantially as described.

12. The method of making abrasive articles which comprises moistening the surfaces of the grains with furfural, mixing the moisened grains with a phenol resin binder in the proportion of about 10 parts by weight of the binder to 90 parts by weight of the moistened grains, molding the mixture under pressure, and then heating it sufficiently to harden the binder, substantially as described.

13. The method of making abrasive articles which comprises moistening the surfaces of the grains with furfural, mixing the moistened grains with between 7 and 15 per cent by weight of a phenol resin binder, molding the mixture under pressure, and then heating it sufficiently to harden the binder, substantially as described.

14. The method of making abrasive articles which comprises adding to abrasive grains furfural in the proportion of from 25 to 40 cubic centimeters of furfural to 1000 grams of the grains, mixing the moistened grains with a phenol resin binder, molding the mixture under pressure, and then heating it sufficiently to harden the binder, substantially as described.

15. The method of making abrasive disks which comprises moistening the surfaces of the grains with a resin solvent, mixing the moistened grains with a phenol resin binder, molding the mixture under pressure into disk form, heating the disk sufficiently to harden the binder, and then cementing it to a backing, substantially as described.

16. The method of making abrasive disks which comprises moistening the surfaces of the grains with furfural, mixing the moistened grains with a phenol resin binder, molding the mixture under pressure into disk form, heating the disk sufficiently to harden the binder, and then cementing it to a backing, substantially as described.

17. The method of making a bonded granular article which consists in moistening the granular material with a resin solvent, mixing a dry comminuted resin therewith, and forming a relatively dry mixture capable of being spread in thin layers with uniformity, then shaping the mixture and baking the same.

18. An article composed of granular material and a resin binder characterized by the fact that the resin immediately adjacent the surfaces of the grains has been spread over the surfaces of the grains in solution so that it is in intimate contact with the grain surfaces while the mass of the resin binder has been maintained in a substantially dry state so that the binder and the particles are evenly and uniformly distributed in the article.

19. The method of making a bonded granular article, containing granular material and a resin binder which consists in intimately distributing the binder over the surfaces of the grains by means of a resin solvent applied to the surface of the grains only, and while maintaining the mass of the resin binder in a substantially dry state so that the binder and particles are capable of being evenly and uniformly distributed, molding the composition in a relatively dry state, and baking the same.

In testimony whereof I have hereunto set my hand.

HARRY C. MARTIN.

Patented Sept. 16, 1930 1,775,631

UNITED STATES PATENT OFFICE

RICHARD PAUL CARLTON, OF ST. PAUL, MINNESOTA, ASSIGNOR TO MINNESOTA MINING & MANUFACTURING COMPANY, OF ST. PAUL, MINNESOTA, A CORPORATION OF MINNESOTA

ABRASIVE ARTICLE AND METHOD OF MAKING THE SAME

No Drawing. Application filed March 13, 1926. Serial No. 94,597.

My present invention relates in general to the treatment of material, preferably in sheet form, and more particularly the treatment of material for the purpose of forming or attaining composite structures, of which well known forms of abrasives such as what is commonly known as sand-paper is an example.

Although I hereinafter disclose the practice of my invention in connection with abrasives such as sand-paper, it will be understood that my invention, or certain features thereof, have a wider field of utility.

Composite structures of the abrasive type such as sand-paper or emery cloth comprises generally, (*a*) a base of sheet material, which may be felted as in the case of paper or woven as in the case of cloth, (*b*) a more or less finely comminuted resistent material having abraiding properties, such as flint, garnet or corundum, and (*c*) a binder or adhesive which serves to bond the abrasive to the base.

The binders or adhesives heretofore employed have been generally of one of two general classes, (*a*) animal glue, of (*b*) vegetable oils and gums or the like.

These two classes of materials are open to certain objections when used for abrasive articles for certain purposes, viz, animal glue is hygroscopic and therefore cannot be successfully used in a water-abrading operation, nor has it thus far been successfully waterproofed as far as known to me, vegetable oils and gums require more or less elaborate treatment to render them satisfactory when used as bases for binders that are stable when used in a water-abrading operation, and both animal glue and vegetable oils and gums are more or less variable in quality and require careful checking and manipulation in order to produce continuous runs of material of an even quality.

The present invention contemplates the provision of a new abrasive article and a new method of making the same wherein there is employed certain resinous material, more particularly synthetic resins, of which certain phenol-aldehyde derivatives such as phenol-formaldehyde condensation products are examples, which viewed from certain aspects present features of novelty, and which can readily be controlled within certain predetermined and desired limits so that abrasive articles closely answering definite specifications can be more readily produced.

In its preferred form, the invention further contemplates the use of chemicals of known and quite definite characteristics whereby I am enabled to attain not only predetermined results as a result of the employment of my improved procedure, but am also enabled to attain certain results that have not been readily if at all obtainable for my purposes or for any purposes by prior procedure known to me.

Again, by synthetizing my improved binder I am enabled to avoid various objectionable features, such as loss of time, needless expense, and other factors due to variability in quality incident to variation in methods of preparation and the presence of impurities in unknown quantities in the cases of animal and vegetable products.

The principal objects of my present invention are the provision of an abrasive article having a binder which functions efficiently; the provision of an abrasive article having a binder characterized by the desired degree of flexibility; the provision of an abrasive article having a binder characterized by extensibility and compressibility to accommodate itself to flexion of the base without permanent distortion or deleterious disintegration; the provision of an abrasive article having a binder characterized by great tensile strength and resistance to shearing stresses; the provision of an abrasive article having a binder which is resistant to certain solvents, such as gasoline, met in certain abrading operations; the provision of an abrasive article having a binder of such a character that it can be manufactured rapidly; and moreover one which has characteristics permitting handling of the product expeditiously and especially one which allows such handling without impairment of the superficies of the material; the provision of an abrasive article having a binder which is advantageous in this that deterioration with age is minimized; the provision of an abrasive article having a binder rendering available certain water or oil abrading operations; the provision of an abrasive article having a binder embodying proportions of basic materials and of modifying agents of predetermined characteristics; the provision of an improved moisture proof abrasive structure; and the provision generally of an improved process for the production of an abrasive article characterized by one or more of the features which are among the objects of the present invention, together with such other objects and further and additional benefits and advantages as may hereinafter appear or be pointed out.

In the employment of my present invention for the production of sand-paper and the like (which I cite for purposes of example) I use as the base such a sheet of material (which may be paper) as will conveniently serve the employment contemplated, and as the abrasive such comminuted material (which may be flint, garnet or corundum, of the desired size) as is similarly adapted to perform the function in view.

It is most desirable that the binder utilized have the functions and characteristics not only of great mechanical strength including toughness, resistance to tensile and shearing strains, and of great binding strength including adhesiveness and tenacity, but also that it be non-hygroscopic, moisture resistent, easily worked, made of materials easily obtainable in the market, inexpensive, facilely worked and applied, of known quality when manufactured, and where used with a base which is penetrable, penetrative of such base so as to form a strong union therewith, and furthermore that it be as resistent as may be to the solvents ordinarily met with in abrading operations as commonly carried out.

I have discovered that resinous materials are preferable not only to gums (which are more or less water soluble) but also to gum-resins and to hardened oils for certain purposes contemplated by me, and particularly synthetic resins as peculiarly adapted for my ends for a number of reasons including that their characteristics can not only be better controlled than is the case with natural products, but that batches having the desired characteristics can be readily reduplicated. I have found that various aldehyde-phenol materials are available, but phenol-formaldehyde products of condensation is preferred by me as a major constituent of the binder, that is as best attaining the desired ends, viewed from certain aspects.

In preparing the binder for use, the resin is used directly in the early stages of reaction, or in connection with a suitable vehicle which I prefer is of such a type as a mixture of alcohol and benzol, for reasons which I will duly proceed to explain.

In applying a resin directly in the early stages of the reaction or prepared with a vehicle such as the stated mixture of alcohol and benzol to one surface of a base of paper, for example, there is involved a penetration of the base by the vehicle carrying along with it particles of the resin, to a point which approximates the opposite surface of the sheet, but preferably falls short of actual exudation of such vehicle and of resin particles to any excessive extent on such opposite surface.

This penetration by the vehicle, particularly when coupled with the use of the character of resin pointed out above results in a moisture proofing of the material against the destructive absorption of moisture through the surface opposite to that to which the binder is applied, and further results in a coating and binding action being secured between the fibres or threads of the base which substantially retards and for all practical purposes entirely prevents the deleterious disintegration of the base at least throughout substantially the effective abrading life of the abrasive article, in addition to preventing access of moisture through the base to the plane of contact between the base and the main mass of the binding material, thus preventing the formation of blisters and rupture of the bond between such main mass and the base which is deleterious even though the bond tenaciously cling to the abrasive particles.

The efficient action of the binder may be enhanced in the manufacture of sand-paper if applied to the base by the means of pressure.

Various degrees of flexibility can be imparted to the binder by the addition of various modifying agents, or combinations thereof or by breaking the binders at intervals after the fabrication of the article has been completed in certain cases.

The substances I have discovered to be particularly adapted to this purpose include glycerol, starch, dextrine, and sugar on the one hand, and various proteins, castor oil and shellac on the other hand.

Sand-paper made in accordance with the disclosure of my present invention is characterized by the desired degree of flexibility without adverse deleterious effects, great resistance to water and moisture generally, and to various other solvents employed in the arts, and a bond of great mechanical strength which is capable of sustaining the grit even in the case of the coarser grits where the strains are relatively high.

The amount of binder to be applied to the base varies according to several variable factors. Among these are (*a*) the thickness of the base, (*b*) the fineness or coarseness of the grit or layer of abrasive particles to be applied to the base, and (c) the contemplated use of the abrasive article. The amount of the binder applied can be regulated conveniently by the application of the binder to the base by means of squeeze rollers spaced for applying a coating or binder of predetermined thickness.

I have found in practice that the number of coats of the binder may also beneficially be varied according to (a) the thickness of the base, (b) the size of the grit, (c) the contemplated use of the abrasive article, and (d) whether the grit be incorporated in the binder before application of the binder to the base, or whether the grit be applied to the binder after such binder has been applied to the base.

I have also discovered that my improved binder may be suitably modified to permit its beneficial use as an auxiliary coating for waterproofing one or both sides of the base, and for applying an auxiliary coating to the grit carrying surface of the abrasive article.

I have further discovered that my improved binder when so suitably modified for use as an auxiliary waterproofing coating may be applied to the surface of the base which is opposite to the grit carrying surface either before or after the application of the bonding coat thereto, or contemporaneously therewith.

I have further discovered that by preheating the abrasive material before applying it to the bonding coat or commingling it therewith, a better bond than is otherwise to be had is attainable. I have found temperatures beneficial for such purposes to range about 150° F. to 175° F.

I have further discovered that the flexibility of the resultant article may be somewhat varied by heat treatment after the application of the binder and grit.

I have further discovered that by carrying out my improved process I am enabled to utilize resinous material without being under the necessity of employing oils in connection therewith, as have been heretofore employed in processes known to me.

While I have had the best results by following out the process hereinafter set forth, I have found it at times convenient and that tolerable results are attainable by the employment of certain synthetic resins obtainable on the market, when dissolved with suitable solvents and otherwise suitably modified, but the results thus had have not within my experience been comparable with those attained when the process is carried out ab initio in the making of the improved abrasive article without retracting any part of the process.

In carrying out my invention, in order that the resinous material may be a known quantity and of known quality I prefer to synthetize a phenol-aldehyde derivative, which may be a phenol-formaldehyde or phenol-furfurol condensation product, suitably modified and manipulated. I also contemplate the use of naphthol and an aldehyde and anthracene and an aldehyde. The treatment to which I subject these elements results in a composition in certain respects possessing novelty.

In producing the desired binder I have employed a number of alternative methods, each of which appears to have certain favorable characteristics and advantages.

One method which has given very good results will now be described in some detail as—

Method No. 1

In this method I employ a mixture of—

1 part commercial phenol (C_6H_5OH).

1 part 40% commercial formaldehyde (CH_2O).

$\frac{1}{10}$ part zinc chloride ($ZnCl_2$).

This mixture is placed in a flask fitted with a reflex condenser. It is heated with a low flame or by an oil bath. The heating is continued at a slow boil until the first appearance of a line of demarcation between the resinous matter (bottom layer) and the water (top layer). To catch this point in the early stages it is necessary to stop boiling to take observations. It is essential that the reaction should be stopped in the early stages to secure the desired fluidity. If the chemicals employed are substantially pure, the resinous matter at this stage is white in color and of the consistency of soft pitch. When it is proposed to use this resinous matter as a primary bonding coat for sand-paper the temperature is preferably maintained at about 100° F. to 150° F. in order to keep the viscosity as low as practicable and as is desirable in order that the material may flow freely. It will thus be seen that I produce by the foregoing method, a new composition of matter having certain characteristics rendering it particularly useful as a waterproof stable bond for sandpaper and the like, these desirable characteristics not being possessed by the composition prior to my treatment thereof nor in its final stage without my treatment. It may now be applied to the backing or base of the abrasive article, in the customary manner, a set of squeeze rolls spaced apart a predetermined degree being employed to determine the thickness of the coating of binder applied to the base. It should be borne in mind that the point at which the reaction is stopped affects the viscosity of the binder and hence the amount applied to the base at a given spacing of the rolls. It is also to be recognized that the relatively coarser grits require a greater thickness of bonding coating than the relatively finer grits and, therefore, that it is desirable to use a more viscous and consequently heavier coating for the coarser grits. In the case of the finer grits I find it expedient at times to employ a mixture Q. S. of alcohol (either CH_3OH or C_2H_5OH) and benzol (C_6H_6) or other solvents or mixtures such as acetone ($(CH_3)_2CO$) an amyl-acetate ($C_5H_{11}OCOCH_3$) for further reducing the viscosity of the resinous material.

If the grit has not been incorporated in the resinous material prior to the application thereof to the bases (as can be done especially in the case of the relatively finer grits) the grit is then applied to the base which has been coated with the resinous binder. In order to enhance the adhesion between the binder and the grit, the grit is preferably preheated to between 150° F. and 175° F. as hereinabove suggested.

In case the back of the base has not been theretofore waterproofed, or if the relative thickness of the paper renders it desirable to compensate for any starving of the bond between the binder and the base which might occur through the penetration of the binder into the base beyond a desired extent, or if the relatively larger size of the grit render such a step desirable in order to compensate for any deficiency in the bonding coat, an auxiliary coat or coats may now be applied, either to the back of the sheet opposite to the grit bearing surface or to such grit bearing surface, or to both.

The abrasive article thus produced is next cured by the application of heat which may conveniently be about 140° F. to 180° F. for a period of time, the duration of which depends on the degree of heat employed and the end point desired. I have used air heated to 165° F. for fifteen hours effectively. A certain degree of curing is necessary in order that the sheet of abrasive material may be insoluble to water. The final reaction may be further carried out by raising the temperature with consequent hardening of the article and increasing its resistance to solvents such as gasoline, alcohol, acetone, ethyl ether, etc.

A certain degree of flexibility is desirable. In the case of the relatively coarser grits, the degree of flexibility desired may be relatively little if any. In the case of the relatively finer grits a relatively high degree of flexibility may be desirable.

I have discovered in practice that the degree of flexibility may be varied somewhat by the heat treatment, that is the length and temperature thereof.

I have also found that especially in the case of the finer grits in order to gain in flexibility it may be desirable to add one or more of the modifying elements such as glycerol, etc., hereinabove mentioned, to the mixture first herein referred to under the caption "Method No. 1". The amount to be added is a matter depending upon certain variable factors, viz, the thickness of the bonding coat and the size of the grit, but the amount ranges too according to the particular modifying agent used. In the case of glycerol, for example, I have found that 20 parts by weight gives good results.

For the $ZnCl_2$ above referred to in connection with "Method No. 1", other catalytic agents may be substituted. Aluminum chloride ($AlCl_3$) and tartaric acid ($C_4H_6O_6$) are examples of these.

As an alternative to Method No. 1 (supra) I have also had good results with what I shall refer to as—

Method No. 2

In this method I employ a mixture of—

1 part phenol, (commercial).

1 part formaldehyde (commercial 40%).

1/20 part ammonia (NH_3 7%, H_2O 93%).

In this method I proceed as above outlined.

In both Method No. 1 and Method No. 2 the reaction is retarded in its early stages so that the resulting resin may be properly manipulated in the coating process. This is effected by discontinuing the heat, and, if necessary, washing the resinous material with water and partly neutralizing the catalyst employed, by suitable reagents which are well-known.

Where the washing is deemed to have removed a considerable portion of the formaldehyde, a small quantity of paraformaldehyde ($(CH_2O)_3$) may be added to the resinous mass before it is utilized. This addition of paraformaldehyde will evolve sufficient formaldehyde gas when subjected to final heating to carry the resinous mass to the end point desired.

Another alternative to Method No. 1 and Method No. 2 with which I have had comparable but less satisfactory results I shall refer to as

Method No. 3

In this method I employ a mixture of—

1 part of commercial synthetic resin, and of a well known and readily obtainable type known to the trade as bakelite resin "A"

1 to 3 parts dissolved in a solvent such as a combination of alcohol and benzol for the primary bonding coat, and

1 part of said commercial resin "A" and

2 to 4 parts of the solvent such as a mixture of alcohol and benzol for the auxiliary coats.

The alcohol and benzol mixture may be varied according to the conditions met in practice, but ordinarily I find that a mixture of equal parts of alcohol and benzol give quite satisfactory service.

I have discovered that in curing the product the best results are attained by controlling temperature between 140° F. and 180° F.

Having thus described my invention and illustrated its use what I claim as new and desire to secure by Letters Patent is:

1. The new article of manufacture, flexible

sandpaper, which includes a backing, a grit or layer of abrasive particles, and a bond for uniting the grit to the backing including a synthetic resinous condensation product which is solidified to a flexible and waterproof state.

2. The new article of manufacture in the nature of sandpaper, which includes a backing, a grit or layer of abrasive particles, and a bond interposed between the grit and said backing for uniting a grit thereto and including an oil modified synthetic resinous condensation product which is solidified to combine with said backing to form a flexible and waterproof article.

3. The new article of manufacture, flexible sandpaper, which includes a backing, a grit or layer of abrasive particles, and a bond for uniting the grit to the backing including a synthetic resinous condensation product which is solidified to a flexible and waterproof state by the application of heat thereto.

4. The new article of manufacture in the nature of sandpaper, which includes a backing, a grit or layer of abrasive particles, and a waterproof, stable adhesive bond for uniting the grit to the backing, said bond including a resinous condensation product of a phenol and aldehyde and a solvent therefor which serves as a vehicle therefor to penetrate the sheet and to solidify to a flexible and tenacious state rendering the article substantially insoluble in the presence of moisture and friction.

5. The new article of manufacture in the nature of sandpaper which includes a grit or layer of abrasive particles and a waterproof stable adhesive bond therefor including a resin which is flexible and insoluble in the presence of water and friction when solidified, the grit being in a heated state when joined with the adhesive bond to cause the latter to flow more intimately into contact with the particles of grit.

6. The process of forming a flexible waterproof abrasive article which comprises condensing an aldehyde and a phenol in the presence of a catalyst at low temperatures to produce an adhesive product, applying such products together with an abrasive grit to a suitable backing, and heating said product whereby to form an abrasive device which is flexible when solidified and insoluble in the presence of moisture and friction.

7. The process of forming a waterproof flexible abrasive article, which comprises applying to a suitable backing an adhesive coating including the initial reaction product of a phenol and an aldehyde in the presence of a catalyst, embedding an abrasive grit, or layer in said adhesive coating, and setting such adhesive whereby to form an abrasive device which is flexible when solidified and insoluble in the presence of moisture and friction.

8. The process of forming a waterproof flexible abrasive article, which comprises applying to a suitable backing an adhesive coating including the initial reaction product of a phenol and an aldehyde in the presence of a catalyst at temperatures between approximately 100° F. to 150° F. embedding an abrasive grit or layer in said adhesive coating, and setting such adhesive whereby to form an abrasive device which is flexible when solidified and insoluble in the presence of moisture and friction.

9. The process of forming a waterproof flexible abrasive article, which comprises forming an adhesive material including the initial reaction product of a phenol and an aldehyde in the presence of a catalyst, adding a solvent for such a product, applying the adhesive material to a backing to penetrate the same, separating the solvent therefrom, and embedding an abrasive grit or layer in said adhesive, and setting said adhesive whereby to form an abrasive device which is flexible when solidified and insoluble in the presence of moisture and friction.

10. The process of forming a waterproof flexible abrasive article, which comprises applying to a suitable backing an adhesive coating including the initial reaction product of a phenol and an aldehyde in the presence of a catalyst, heating an abrasive grit and applying the same while hot to said coating to cause an intimate association of said coating and said grit, and setting such adhesive whereby to produce an abrasive device which is flexible when solidified and insoluble in the presence of moisture and friction.

In testimony whereof I have hereunto signed my name.

RICHARD PAUL CARLTON.

100 [Stamp:] Mailed Jan. 18, 1933.

CRC:ERD. Paper No. 17.

Department of Commerce,
United States Patent Office,
Washington, D. C.

January 18, 1933.

In re application of Lawrence V. Redman. Serial No. 214,-219. Filed Aug. 19, 1927. For Abrasive Implement.

Before the Board of Appeals.

Examiner's Statement.

Applicant appeals from the action of the Examiner finally rejecting claims 10 and 11, which read as follows:

10. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.

11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

The reference is patent to:
Carlton, 1,775,631, Sept. 16, 1930.

The invention called for by these claims consists of an abrasive sheet of the nature of sandpaper in which the abrasive grains are cemented to a flexible backing sheet by a phenol-aldehyde synthetic resin.

Claims 10 and 11 were rejected as being met by patent to Carlton.

Patent to Carlton discloses an abrasive body consisting of a sheet of flexible material for a backing element and a flexible binder consisting of a phenolic body and an aldehyde for fastening the abrasive grains to the backing sheet.

101 The rejection of claims 10 and 11 on patent to Carlton is believed to be proper. Carlton discloses an abrasive sheet, which has the abrasive fastened to the backing by means of a flexible phenol-aldehyde resin. The claims call for an abrasive sheet, which has the abrasive fastened to the backing by means of a flexible phenol-aldehyde resin. These two claims are very broad and if there is any difference between the article of these claims and that of the reference, the claims do not point out such a difference as is required by Sec. 4888 U. S. R. S.

Respectfully,

E. F. DOWELL,
Examiner, Div. 58.

102 [Stamp:] U. S. Patent Office, Board of Appeals. Jun. 5, 1933. Mailed.

Appeal No. 8280. OVT.

Hearing: May 4, 1933.

In the United States Patent Office.

Before the Board of Appeals.

Ex parte Lawrence V. Redman.

Application for Patent filed August 19, 1927, Serial No. 214,219. Abrasive Implement.

Messrs. Byrnes, Townsend & Potter for applicant.

This is an appeal from the action of the examiner finally rejecting claims 10 and 11.

Claim 11 is illustrative:

11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder

including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

The reference relied upon is:

Carlton, 1,775,631, Sept. 16, 1930.

Applicant's purpose is to provide a non-rigid or flexible bond of phenolic resin type to secure abrasive grains to a flexible base in the formation of abrasive implements of the type of emery paper. He prefers to use the reaction product of phenol and tung oil which product is
103 hardened with hexamethylenetetramine or other methylene-containing or aldehyde hardening agent. As a specific example the specification refers to the resinous compositions described in the patent to Byck No. 1,590,079.

The examiner has allowed claims 8 and 9 which are quite similar to the claims on appeal but require a phenol-oil-resin reaction product. He regards the appealed claims as being so broadly drawn as failing to patentably distinguish from the patent to Carlton.

Carlton, like the applicant, is concerned with the production of flexible abrasives of the sand paper type and employs similar synthetic resins either alone or with modifying agents to increase the flexibility of the cured binder. Applicant urges that in the former case Carlton obtains a flexible binder only because it is under-cured and in the latter case in which a plasticizer is used, the appealed claims are not met since they require a flexible binder in the absence of added plasticizer. We are not satisfied that the difference, if any exists, is more than a difference in degree. Lines 32-45 inclusive, page 4 of the patent, indicate that a flexible binder of the desired resistance to solvents and heat is secured without the addition of a plasticizer. Applicant's product is described at the top of page 4 of the application as being free from substantial tendency to fuse or become tacky at the highest temperatures developed during use. Furthermore the Byck patent emphasizes the plasticizing effect of the tung oil employed in the composition. It seems to us in view of this state of facts that applicant is not entitled to the appealed claims but on the other hand the claims which have 104 been allowed him by the examiner furnish protection commensurate with the advance he has made in the art.

The decision of the examiner is affirmed.

M. J. MOORE,
Assistant Commissioner,
EUGENE LANDERS,
Examiner-in-Chief,
W. L. THURBER,
Examiner-in-Chief,
Board of Appeals.

June 5, 1933.

(Here follows specification, side folios 105 and 106.)

Endorsed on cover: District of Columbia Supreme Court. No. 6523. Bakelite Corporation, Appellant, vs. Conway P. Coe, Commissioner of Patents. United States Court of Appeals for the District of Columbia. Filed July 27, 1935. Henry W. Hodges, Clerk.

UNITED STATES PATENT OFFICE.

LEO H. BAEKELAND, OF YONKERS, NEW YORK.

ABRASIVE COMPOSITION AND METHOD OF MAKING SAME.

942,808. Specification of Letters Patent. **Patented Dec. 7, 1909.**

No Drawing. Application filed October 26, 1907. Serial No. 399,382.

To all whom it may concern:

Be it known that I, LEO H. BAEKELAND, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Abrasive Compositions and Methods of Making Same, of which the following is a specification.

This invention relates to abrasive, grinding or polishing compositions, and the object of the invention is to provide a composition suitable for abrasive purposes or for grinding, polishing or like operations, and a method of making the same.

It is well known that abrasive or polishing materials such as carborundum, corundum, emery, sand, glass-powder, iron oxid, pumice, infusorial earth and the like, in pulverulent form, may be compounded with clay, glue, shellac, rubber, nitrocellulose, resinous bodies, etc., and formed into grinding wheels, sharpening stones and other abrasive and polishing implements. I have discovered that the infusible and insoluble condensation products of formaldehyde and phenol or its homologues, compounded with abrasive, grinding or polishing materials in a suitable state of subdivision, yield compositions possessing novel qualities of characteristics and presenting marked advantages over the abrasive compositions heretofore known. These advantages result from the physical and chemical characteristics of the composition, as well as from the simplified manufacture and low cost of the product.

My abrasive composition may be prepared as follows: Commercial phenol or its homologues, hereinafter referred to as a phenolic body, is mixed with commercial formaldehyde, usually in approximately molecular proportions. This proportion may however be considerably varied to meet particular requirements. To the formaldehyde-phenol mixture I add a suitable pro- [illegible] granular abrasive [illegible] and depending entirely on the degree of hardness, compactness or coherence desired in the final product. The thoroughly mixed mass is now hardened by submitting it to the action of heat, either at temperatures about 100° C., or below, in which case, the hardening process is comparatively slow, or at higher temperatures, in which case, the hardening proceeds rapidly. In case higher temperatures are employed the hardening may proceed in whole or in part under the combined action of heat and increased pressure, the employment of pressure being for the purpose of preventing any lack of homogeneity or uniformity of the product due to emission of vapors with such rapidity as to cause swelling, bloating or foaming of the mass. The mass may be kept in a suitable mold during the entire hardening process, or the first stages of the hardening process may be carried out in any suitable vessel, from which the partially hardened or plastic mass may be transferred to any desired mold; or the mass may be applied as by coating or painting or otherwise to any desired surface serving as a support. During the reaction induced by the aid of heat the formaldehyde-phenol mixture changes into an infusible product insoluble in all ordinary solvents and unattacked by most chemical reagents. Its properties of withstanding high temperatures and chemical action render it most valuable for compounding with abrasive grinding and polishing materials. After the hardening process the mass may be submitted to further drying to expel any water or other volatile substances. The hardening or condensation process can be considerably accelerated by the addition of small quantities of catalytic or condensing agents, such for instance as acids, bases or salts.

During the condensation of the phenol-formaldehyde mixture to the infusible and insoluble product described a considerable quantity of water is liberated, and this may necessitate subsequent drying. Under certain conditions the liberated water may during the reaction period distribute itself unevenly throughout the mass in such manner as to impair its uniformity, and it may therefore be necessary in special cases to use anhydrous phenol and anhydrous formaldehyde, or a mixture of phenol and the polyparaform). The employment of these materials however involves additional expense, and I have discovered that a substantially dehydrated mixture of formaldehyde and phenol may be prepared by adding to the mixture of commercial phenol or its homologues and formaldehyde any readily water-soluble salt that possesses the property of abstracting water from the mixture. This separation of water can be effected most readily and inexpensively by the use of ordinary commercial sodium chlorid. If salt be added to a mixture of commercial formaldehyde and phenol the liquid separates into two layers; the heavier layer consists substantially of saturated brine containing small amounts of phenol, formaldehyde and other water-soluble products, while the lighter layer is of an oily character and comprises a substantially dehydrated mixture of phenol and formaldehyde or reaction products thereof. This lighter layer or oily liquid is soluble in alcohol, acetone and like solvents and is excellently adapted for the purposes of this invention, as well as for the numerous other purposes for which the hard, insoluble condensation product prepared therefrom is suitable. Or instead of adding a water-soluble salt I may heat a mixture of phenol and formaldehyde, preferably in a closed vessel or in an apparatus provided with a return condenser, until the mixture separates into two liquid layers, the one aqueous and lighter, and the other oily and heavier. The oily liquid may then be separated for use as above. Or instead of withdrawing the oily layer the mixture may be further concentrated until the water has been expelled by evaporation. In either case the addition of small amounts of catalytic or condensing agents, as above described, will be found to accelerate the first stage of the reaction. The oily liquid however obtained may now be mixed with the desired proportion of pulverulent or granular abrasive material, after which the mixture is submitted to further heating or drying, either with or without the combined action of increased pressure.

The initial condensation product above referred to as possessing the characteristics of an oily liquid may be further heated or dried before mixing with the abrasive material, and under such treatment it will acquire increased viscosity until a point is attained at which [illegible] is of a sticky, plastic or rubber-like consistence but has not yet acquired the properties of infusibility and insolubility characteristic of the final product. In this plastic condition the condensation product is capable of mixing readily with any abrasive material, and the composition formed by such mixture is ready to be subjected to further molding and hardening operations as described above.

For the purposes of this invention the partial reaction products of phenolic bodies and formaldehyde are to be regarded as equivalent to mixtures of these compounds.

In order to facilitate the mixing of the ingredients or to impart a desired color to the ultimate mass or to modify its properties in any respect, the addition of suitable proportions of other materials may be resorted to, as for instance solvents, dyes, pigments, or other solid or liquid materials.

The abrasive composition may before the final hardening be pressed or molded in suitable forms or molds, or while it is still plastic or liquid it may be applied, coated or painted on wood, paper, metals, or any other materials which it may be found advantageous to use as supports; after application to such materials it may be hardened and rendered insoluble by drying or heating as described above.

I claim:

1. The method of making an abrasive composition which consists in incorporating an abrasive material with a phenolic body and formaldehyde and transforming the same into an insoluble condensation product.

2. The method of making an abrasive composition which consists in incorporating an abrasive material with a phenolic body and formaldehyde and transforming the same into an insoluble condensation product by application of heat.

3. The method of making an abrasive composition which consists in incorporating an abrasive material with a phenolic body and formaldehyde and transforming the same into an insoluble condensation product by application of heat and pressure.

4. An abrasive or polishing composition containing an abrading or polishing agent, and an insoluble condensation product of a phenolic body and formaldehyde.

In testimony whereof, I affix my signature in presence of two witnesses.

LEO H. BAEKELAND.

Witnesses:
Mary L. Short,
Mary E. Scholding.

FILED OCT 21 1935

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

No. 6523.

Bakelite Corporation, *Plaintiff-Appellant,*

against

Conway P. Coe, Commissioner of Patents,
Defendant-Appellee.

BRIEF ON BEHALF OF PLAINTIFF-APPELLANT.

Richard L. Scheffler,
Solicitor for Appellant.

Charles H. Potter,
Ralph E. Parker,
Jos. N. Nielsen,
Of Counsel.

Press of Byron S. Adams, Washington, D. C.

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IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

No. 6523.

Bakelite Corporation, *Plaintiff-Appellant,*

against

Conway P. Coe, Commissioner of Patents,
Defendant-Appellee.

BRIEF ON BEHALF OF PLAINTIFF-APPELLANT.

This is an appeal from a final decree of the Supreme Court of the District of Columbia dismissing plaintiff-appellant's bill of complaint (Rec. page 1), in a suit under Section 4915 of the Revised Statutes, in accordance with an opinion rendered by his Honor Judge Cox holding that plaintiff-appellant is not entitled to a patent covering claims set out in the bill (Rec. page 3).

STATEMENT.

The subject matter of this suit is the right of plaintiff-appellant to a patent, on an application filed by Lawrence V. Redman, for Abrasive Implement, Patent Office Serial No. 214,219, filed August 19, 1927, for the invention specified in certain claims as recited in their bill of complaint. Said application was finally refused by the Commissioner of Patents, whereupon this suit was brought under the provisions of Section 4915 of the Revised Statutes (35 U. S. Code Sec. 63) to secure issuance of patent. It has been admitted by the defendant-appellee that the entire right, title and interest in and to the said application, and the invention covered thereby, are now vested in the appellant, Bakelite Corporation.

ERRORS RELIED UPON.

Appellant relies upon each of the errors recited in the Assignment of Errors (Rec. page 10). More particularly, appellant's position may be summed up in the statement of error reading:

> "III. The Court erred, in matter of law, in concluding that the subject-matter of the claims of the aforesaid application recited in the bill of complaint herein is unpatentable over the prior patents, including U. S. patent No. 1,775,631 to Carlton, adduced by defendant."

SUBJECT MATTER OF THE APPLICATION IN SUIT.

The aforesaid Redman application involved herein relates to the provision of a flexible abrasive implement, and is limited to an abrasive article, in the nature of sand paper, composed of a flexible backing sheet, *e. g.*, paper, to which abrasive grains, *e. g.*, sand, are bonded by means of a resinous bonding material or adhesive which is (a) inherently flexible at normal and elevated temperatures, (b) infusible at all temperatures, and (c) non-tacky under all conditions of use. The abrasive sheet of the invention is strong, durable, and inert to moisture, common solvents and atmospheric conditions, as well as flexible and infusible.

The application when finally refused by the Commissioner of Patents contained, among others, the following claims:

> 10. As a new article of manufacture an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product *per se* when set by the action of heat to the infusible stage.
>
> (Claim A of the bill of complaint); and
>
> 11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.
>
> (Claim B of the bill of complaint.)

The bill of complaint prayed for the allowance of the two claims above recited, and also for the allowance of a third claim reading as follows:

> As a new article of manufacture, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a bond which is flexible at normal and higher temperatures, but infusible at all temperatures, and non-tacky under all conditions of use.

Certain specific claims stand allowed.

The thing sought to be patented by appellant is a flexible abrasive implement as a new article of manufacture—not a new resin or a new resinous composition or a new chemical compound. The flexible abrasive implement of the invention is a combination of three elements, viz:

1. A flexible base (*e. g.*, paper or cloth);
2. Abrasive grains; and
3. A binder, for securing the grains to the base, characterized by being
   - (a) a condensation product of a phenolic body and an aldehyde which product when set by the action of heat to the infusible stage is *per se* marked by inherent flexibility (claim 10); or
   - (b) a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer (claim 11); or
   - (c) a bond which while being infusible at all temperatures nevertheless is flexible at normal and higher temperatures (claim recited in prayer of bill of complaint).

Common to all these definitions of the bonding agent of the new article of manufacture are the combined limitations of infusibility and flexibility.

By means of this combination of elements comprising a flexible base, abrasive grains and a bonding agent of infusible character but flexible in that infusible form, there is provided for the first time in the history of the sandpaper industry a flexible paper in which the bond does not fuse or soften when heated in an abrading operation to interfere with the cutting action of the grains and lose its adhesiveness for the grains.

In addition, the infusible nature of the bond imparts to the flexible sandpaper those propetries of strength, durability and inertness to moisture, common solvents and atmospheric conditions which are characteristic of the bonding agent in its infusible state. That is the contribution made by this invention, a new flexible sandpaper having in addition to the property of flexibility the property of infusibility and the other properties enumerated.

It may not be amiss, at this point, to offer brief explanations or definitions of certain of the expressions occurring in the claims recited, or referred to, in the bill.

By the expression "a condensation product of a phenolic body and an aldehyde" is meant a synthetic resin formed by reacting an aldehyde (such, for example, as formaldehyde) with a phenolic compound which might be phenol itself, or another aromatic hydroxyl compound similar to phenol (such, for instance, as cresol), or a compound obtained by initially reacting a phenol with an unsaturated organic body (such, for instance, as an unsaturated fatty oil) whereby to produce a new phenolic compound from which neither phenol, as such, nor unsaturated organic body, as such, can be separated. The expression covers the phenolic synthetic resins so commonly employed in molded articles, varnishes, insulations, etc.

The expression "set—to the infusible stage" means hardened to a condition wherein the resin cannot be caused to flow by heating. In explanation, it may be noted that some synthetic resins are permanently fusible (*i. e.*, cannot, by continued heat-treatment, be brought into a condition wherein they no longer can be fused) while other synthetic resins are heat-harden-able to the infusible stage or state: the present invention is concerned only with the latter type of resins. At the trial an expert witness explained that use of a fusible resin as bonding agent in a sandpaper gives rise to the disadvantage that when the same is heated by friction of the sandpaper on the work the fusible resin becomes sticky so that loose particles abraded from the work adhere to the softened bond and fill up or "load" the paper so that it no longer is useful as an abradant.

By the expression "plasticizer" is meant "a substance added to a plastic like resin or cellulose products for the purpose of rendering it softer and more plastic, and is normally a liquid product which exists in solution or perhaps loosely held in the mass—. It can normally be found as a separate chemical present in the mass" (Rec. page 14). A "plasticizer", then, is a substance which when admixed with a resin is and continues to remain a distinct entity in the resinous composition; it *does not react* with the resin, or lose its identity in the resulting composition but rather can be separated from the latter by physical means. Commonly recognized plasticizers for synthetic resins include glycerin and castor oil.

A "plasticizer" to be at all useful in a composition must have a solvent action on the thing to be plasticized. Because of the known fact that infusible phenolic resins are practically insoluble in solvents, the opportunity to plasticize an infusible phenolic resin is practically nil (Record page 15). Addition of a "plasticizer" to an infusible phenolic resin definitely depreciates the *adhesiveness* of the resin (Record, page 16), a quality which is of primary importance in a sandpaper bond.

PIONEER CHARACTER OF THE INVENTION.

Never before in the history of the sandpaper industry had there been made available to it a paper of flexible character in which there was no fusion or softening in an abrading operation to interfere with the adhesiveness of the bond and the abrading action of the grains, and in which flexibility was an inherent property of the paper without reliance upon a changing condition in the bonding agent. The desirability of this combination of permanent inherent flexibility with infusibility or inertness to heat in an abrading operation had long been recognized in the sandpaper industry. But before Dr. Redman's invention it had not occurred to anyone how this property could be imparted to sandpaper. The abrading industry relied mostly on glue as a bond; but glue does not combine these properties, and it is particularly objectionable in that it softens in use thereby losing its adhesive strength and coats the grains to interfere with their cutting action; likewise glue has no resistance to moisture and is valueless as a bond for paper to be used with water or other liquids in a wet abrading operation. It remained for Dr. Redman to teach the industry how such a sandpaper combining permanent or inherent flexibility and infusibility could be produced.

Dr. Redman accomplished this object of providing a new flexibile infusible sandpaper by turning to the field of *flexible resins* for a bonding agent. He discovered that a flexible resin could be applied to a flexible base, that it had good adhesive strength for securing abrasive grains to the flexible base and that it did not interfere with the flexible nature of the base or with the cutting action of the grains when brought to the infusible state. It is not here contended that he taught the industry how to make a flexible resin or that his invention lies in the flexible resin as such, because flexible resins were, *per se*, known. What he did discover and teach the abrasive industry was that by combining the elements of a flexible base, abrasive grains and a flexible resin as a bonding agent (which latter could be set to the infusible state and remain flexible in that state), a flexible abrading paper or cloth could be obtained. This was a radically new departure in the sandpaper art, a result that had not theretofore been achieved, and this is indicative of the pioneer character of the invention. It meets an old or recognized want by a new means of approach.

Indicative of the Federal Supreme Court's attitude toward pioneer inventions is the decision in *Morley Sewing Machine Co.* v. *Lancaster*, 129 U. S. 263. This decision by the United States Supreme Court is believed to be particularly pertinent. Beginning with page 273 of the reported decision the Court discusses primary or pioneer inventions. It states that as Morley was the first person to succeed in producing an automatic machine for sewing buttons he is entitled to a liberal construction of the claims of his patent. Reference is made to a prior decision in *McCormick* v. *Talcott*, 20 How. 402, quoting therefrom the statement: "If he be the original inventor of the device or machine called the divider, he will have a right to treat as infringers all who make dividers operating on the same principle, and performing the same functions by analogous means or equivalent combinations, even though the infringing machine may be an improvement of the original, and patentable as such".

The decision likewise makes reference to *Railway Co.* v. *Sayles*, 97 U. S. 554 and quotes "Like almost all other inventions, that of double brakes came when, in the progress of mechanical improvement, it was needed; and being sought by many minds, it is not wonderful that it was developed in different and independent forms, all original, and yet all bearing a somewhat general resemblance to each other. In such cases, if one inventor precedes all the rest, and strikes out something which includes and underlies all that they produce, he acquires a monopoly, and subjects them to tribute".

Again quoting from *Clough* v. *Barker*, 106 U. S. 166, the decision states: "But Clough was the first person who applied a valve regulation of any kind to the combination to which he applied it, and the first person who made such combination; and he is entitled, under decisions heretofore made by this Court, to hold as infringements all valve regulations, applied to such a combination, which perform the same office in substantially the same way as, and were known equivalents for, his form of valve regulation". The decision goes on to say that the same doctrine was applied in the *Consolidated Valve Co.* v. *Crosby Valve Co.*, 113 U. S. 157, holding "that the prior structures never effected the kind of result attained by his apparatus, because they lacked the thing which gave success; and that, taught by Richardson, and by the use of his apparatus, it was not difficult for skilled mechanics to take the prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by him". Numerous other decisions were explained as supporting the view taken and on page 296 the questions urged are applied to the case in hand in the following terms: "The Morley patent is to receive a liberal construction, in view of the fact that he was a pioneer in the construction of an automatic button-sewing machine, and that his patent, especially in view of the character and terms of the four claims in question, is not to be limited to the particular devices or instrumentalities described by him, used in the three main elements of his machine, which, combined together, make it up. This is the principle applied by this Court in *Consolidated Valve Company* v. *Crosby Valve Company*, 113 U. S. 157".

Being of a pioneer character, the present invention is entitled to a liberal construction and is not to be limited to the particular devices or instrumentalities specifically described (*Morley* v. *Lancaster, supra*).

Liberality in the construction of pioneer inventions is an established doctrine which is expressed in, among others, the following decisions believed to be pertinent here:

Hildreth v. *Mastoras*, 257 U. S. 27.

This decision rendered by the United States Supreme Court states: "As the Dickinson patent is a generic patent, the doctrine of broad equivalents properly applies here. *Morley Sewing Machine Co.* v. *Lancaster*, 129 U. S. 263, 273; *Miller* v. *Eagle Manufacturing Co.*, 151 U. S. 186, 207; *Paper Bag Patent Case*, 210 U. S. 405".

The invention covered by the Dickinson patent was a candy-pulling machine. The Court held that the patentee who "took the important but long-delayed and therefore not obvious step from the pulling of candy by hand to the performance of the same function by machine, the ultimate effect of which, with the mechanical and patentable improvements of his device, was greatly to reduce its cost and to enlarge the field of the art, was a pioneer".

The pioneer nature of the invention is stressed for it appears to have been the position of counsel for the Patent Office and to have been the attitude of the Court below that Dr. Redman is to be restricted to that specific flexible resin which he selected as being particularly useful for the accomplishment of the invention. In other words, the new approach pointed out by Dr. Redman to sandpaper manufacture, whereby such a paper combining flexibility and infusibility was first provided is only to be protected to the extent of the specific bonding agent that he used. The principle he disclosed is to be left available to others, thereby enabling others to take advantage of the teaching of the Redman disclosure and yet escape infringement of the claims thereof; such a position is contrary to established practice (*Morley v. Lancaster, supra*).

Equivalents of the specific flexible resinous bond disclosed by Dr. Redman, as being a preferred bonding material for use in fabricating the novel article of manufacture claimed by him, were known at the time this invention was made (Rec. page 6), and were referred to in the Redman disclosure (Rec. page 25; page 3, lines 20 to 31 inclusive of the Redman application). While Dr. Redman mentioned in his application that his preferred bonding agent was a resinous reaction product of a phenol with oil and a methylene-containing agent such as had been described in U. S. patent No. 1,590,079 to Byck, he expressly referred to the fact that at the time he made his invention there were known other flexible phenolic resins, and stated that any of these could be used as the bonding agent of his new article of manufacture.

PRIOR ART RELIED UPON BY THE PATENT OFFICE.

In the answer filed by the Patent Office, paragraph 8 cites six United States patents, including U. S. patent No. 1,775,631 to Carlton. No contention has been made that any of these patents, other than the Carlton patent, meet the subject matter of claims A and B, nor was any one of the five additional patents applied to appellant's claims at the trial below. No detailed reference need be made to them, but a brief description is submitted. Byck patent No. 1,590,079 describes a method of making a flexible type of resin; it is mentioned in the present Redman application. It is not at all concerned with the manufacture of sandpaper. The Redman patent No. 1,591,999 merely discloses the manufacture of a phenol resin without any reference to sandpaper manufacture; the resin so made is not flexible but brittle and rigid. The Low patent No. 1,243,312 has nothing to do with sandpaper or with the manufacture of flexible bonding agents or resins; it merely describes overcoming the softness of natural resins by making them harder so that they melt at higher temperatures. The Martin patent No. 1,626,246 like the Baekeland patent makes use of the rigid, brittle type of resin as a bond for making rigid non-flexible grinding wheels. The Crupi patent No. 1,468,960 relies upon glue as a bonding agent for securing grains to paper and proposes to give water-proofness to the paper by a sizing coating to protect the glue bond; the bond is not infusible but is the common glue bond which softens on heating. It is evident that none of these five patents have pertinency with respect to the issue presented by the claims recited in the bill.

The Disclosure of the Carlton Patent.

The Carlton patent No. 1,775,631 relates to the manufacture of sandpaper, and discloses a combination of flexible backing, abrasive grains and a bond for binding the abrasive grains to the backing, the bond being a phenolic resin.

The Carlton patent states that synthetic resins, broadly, and preferably phenol-formaldehyde products, as bonding agents accomplish the object of his invention. Specifically, the restin described by Carlton is a typical phenol-formaldehyde resin which when hardened to infusibility is a brittle, rigid body. Carlton himself so states, on page 4, line 55 of his patent, that the degree of flexibility may be varied somewhat by the heat treatment and in line 48 that the degree of flexibility may be relatively little if any. In other words, the resin used as a bonding agent is of such a character that as heating is continued the agent loses its flexibility and becomes rigid.

Since, as patentee himself inferred, his resinous bond is such that when set to the infusible stage it is not flexible but rather is rigid (page 4, lines 52 to 55 inclusive of the Carlton patent) it does not, then, combine in itself the physical characteristics of infusibility and flexibility. Ignoring the property of infusibility—as the Patent Office Examiner and Board of Appeals have done—there is still lacking in the Carlton disclosure a resin characterized by inherent flexibility, since the flexibility of his resin is but a condition attending the resin in an intermediate stage and disappears with heating.

Virtually admitting that his resinous bond was, *per se*, rigid when set to the infusible state, and therefore valueless in the production of *flexible* sandpaper, patentee then described the association of a "plasticizer" with his rigid resin as being a means of conferring flexibility upon the resinous bond (page 2, lines 105 to 115 inclusive, and page 4, lines 56 to 69 inclusive, of the patent). The plasticizer might be glycerol, starch, dextrine, sugar, various proteins, castor oil or shellac: where glycerol was to be employed patentee taught to add it in an amount approximately 10 times that of the resin (page 4, lines 66 to 68 inclusive of the patent). That such a combination would be utterly valueless is obvious, since it would be permanently liquid.

It is to be emphasized, however, that in patentee's composition consisting of glycerol 20 parts and phenolic resin 2 parts the plasticizer (*i. e.*, the glycerol) is a distinct entity: it can be separated from the resin by purely physical means and has in nowise lost its identity as glycerol. The *resin* of the composition remains the same as before, namely, a phenolic resin which when set to the infusible stage is rigid (*i. e.*, non-flexible). Moreover, since the resin and plasticizer are not chemically combined, the plasticizer if liquid separates from the resin as the latter becomes "set", coating the abrasive grains (Rec. page 51) and softening the paper backing.

The plasticizer-resin composition of the Carlton patent does not, then, meet the terms of the appellant's refused claims any more than does the unplasticized resin of that patent, *because in each case there is used a resin which, per se, is rigid and inflexible when set to the infusible stage* (Rec. pages 14, 15, 16, 19, 49, 50 and 51).

Accordingly the Carlton disclosure fails as an anticipation of appellant's claims in both of the following respects:

1. It does not disclose a flexible abrasive paper in which the bonding agent is characterized by flexibility *and* infusibility;
2. It does not disclose a flexible abrasive paper in which the bonding agent is one having *inherent* flexibility.

For these reasons alone, based on the description contained in the patent itself, it cannot be regarded as anticipating the claims recited in appellant's bill. The expert testimony, adduced at the trial, fully substantiates the inferences logically flowing from the Carlton disclosure.

THE TESTIMONY.

a. Dr. Bender's Testimony.

Dr. Bender, who is an expert in the resin art, was first called to testify. He was working on the flexible type of resin, and he was called upon by Dr. Redman to experiment with the preparation of flexible sandpaper in accordance with Dr. Redman's directions. At the time of this development resins prepared from phenol were known, but they were hard, brittle bodies (Rec. page 14). The art showed many attempts to reduce the brittle property by adding to the resin some other property (Rec. page 14); but such a process of plasticizing was difficult (Rec. page 15) and the product was still brittle and not suited for flexible sandpaper (Rec. pages 15, 16): plasticizers also had the tendency to destroy the bonding or adhesive character of the resin (Rec. page 16).

The new development resulting in flexible resins was an entirely new approach to the problem of imparting flexibility and a radical departure from prior resin products (Rec. page 16). It involved the reaction of an unsaturated fatty oil with phenol to give a new phenolic body which latter reacted with aldehyde to make a resin: the new principle suggested the substitution of any unsaturated body for the fatty oil to obtain flexibility (Rec. page 16).

Dr. Bender was acquainted with the Carlton patent cited by the Patent Office, and in his testimony gave his opinion of the Carlton disclosure. The early reaction stage material described by Carlton could hardly be described as flexible (Rec. page 16) but with a maximum amount of plasticizer it would be flexible *in that early stage* of resinification: to have any value it must be heat-treated beyond that point where it would no longer be flexible. When cured to the extent specified by Carlton in his "Method No. 1" (page 3, beginning line 81 of the patent) the bond would be brittle and not flexible (Rec. page 17).

Dr. Bender prepared an affidavit which was made of record in the prosecution of the application and this affidavit was given no consideration whatsoever by the Patent Office. According to that affidavit and as explained in his testimony at the trial, he made samples following the Carlton patent disclosure (Rec. pages 16, 17). Two samples, one with the resin alone and marked XK-2636 (Exhibit No. 2) and one with resin plasticized with castor oil and marked XK-2637 (Exhibit No. 3) were made at that time; these two samples were brittle and non-flexible, and their bonding action was poor (Rec. pages 16, 17).

In addition, two other samples were submitted with the affidavit: one, marked XK-2720 (Exhibit No. 4), was made by Dr. Bender in accordance with the Redman disclosure, and the other, XK-2723 (Exhibit No.

5), was a commercial paper made by Armour & Company in accordance with the Redman disclosure and was made in 1929. These latter two samples are very good flexible papers (Rec. page 17).

Dr. Bender was questioned specifically as to the Examiner's statement concerning the Carlton patent (Rec. page 17) and as to his opinion as an expert. He found no teaching in the Carlton patent as to how to confer flexibility upon patentee's resinous bond. He further could see no similarity in the resin described by Carlton and the resin described by Redman (Rec. page 17) as alleged by the Patent Office Board of Appeals in its decision. He furthermore found no support for the Board's conclusion that any difference was a difference of degree; in his opinion the difference was one in kind, since Carlton modified his resin by adding *plasticizer* while Redman's resin was a new type *obtained by chemical reaction* (Rec. page 17).

b. Mr. Courtney's Testimony.

Mr. Courtney was requested to investigate the Carlton patent, and to this end he took some resins which Dr. Bender had made following the Carlton patent and tried them on tin and paper (Rec. page 17). He found the resins as Carlton describes them were so green—that is, the reaction period had been so short—that smooth films were not obtained and when they were heat-treated to the point of being unaffected by water they were quite brittle and unsuited for flexible sandpaper (Rec. pages 17, 18). The resins modified by plasticizers gave essentially the same results (Rec. pages 18, 19). To be commercially useful, a flexible sandpaper must be one which can be bent sharply so that it can be used on irregular surfaces and over corners (Rec. page 18).

He followed these experiments with further tests in which he made the resins himself following the Carlton patent. Samples so prepared were put in evidence (Exhibits 6, 7, 8 and 9), two of these being with the resins *per se* as bonds and two of them with glycerine as a modifying agent for the resin (Rec. page 18). All of these samples were too brittle to be useful, and Exhibit 7, including glycerine as a plasticizer, had no adhesive action whatever for the abrasive grains.

Incidentally, in his experiments Mr. Courtney noticed a significant fact concerning zinc chloride as a catalyst in Carlton's method No. 1. Carlton in his patent states that the resin separates as a bottom layer. Actually, however, the reverse is true; the resin is present in the top layer and the water layer is at the bottom, thus leading to the conclusion that Carlton never tried the experiment (Rec. page 18).

Mr. Courtney again made a series of samples modifying the disclosure of Carlton with the end in view of getting a sandpaper bond if possible (Rec. pages 18, 19). The reaction was carried for a longer period and there was a material improvement in the results (Rec. page 19). But as flexible sandpapers the samples made (Exhibits 10, 11, 12 and 13) were useless as they did not have flexibility. In no instance was Mr. Courtney, an expert in this art, able to get a usable sandpaper following the Carlton disclosure (Rec. page 19).

c. Conclusions Drawn From the Testimony.

The testimony of both Dr. Bender and Mr. Courtney establishes conclusively that no flexible sandpaper could be made by following the Carlton patent. The disclosure of the patent, therefore, is inoperative. This testimony further establishes that the *Carlton patent does not disclose a sandpaper having as a bonding agent a resinous body characterized by the combined properties of flexibility and infusibility*. It further establishes that the Carlton patent does not disclose sandpaper in which a resinous bond having inherent flexibility is used. In these respects, then, the testimony clearly supports the conclusion heretofore drawn from the Carlton patent itself.

To be an anticipation of applicant's claims it is essential that the Carlton patent disclose an abrasive paper with a bonding agent having these physical properties of infusibility together with flexibility, or flexibility inherent in the bonding agent itself. It is additionally necessary, in order to be a valid reference, that the disclosure be such as to teach anyone skilled in the art to obtain the results therein set forth: the Carlton patent does not do this. In these various respects then it is not a proper reference.

THE PATENT OFFICE'S POSITION.

Claims A and B were passed upon both by the Examiner and by the Patent Office Board of Appeals. The only ground of rejection advanced as evidenced by the Examiner's Statement and the decision of the Board is anticipation by the disclosure of the Carlton patent No. 1,775,631. No objection had been raised against these claims, nor was there any other ground of rejection of record. There had been no intimation in the course of the Patent Office proceedings that the claims are not proper definitions of an article, or that they are of undue breadth such as to cover future improvements.

It appeared from the remarks made by defendant's counsel at the trial that appellant's claims are only entitled to consideration to the extent that they define the specific chemical composition of the bonding agent; according to him the recitation of physical properties characterizing the bonding agent is to be entirely ignored. But novelty and utility of the present invention is not here predicated on novelty of the chemical constitution of the bonding agent any more than it is on the chemical composition of the grains or of the base; and if the bond must necessarily be limited to a particular chemical reaction product, these other elements of the combination logically should also be restricted to the particular chemical compositions of base and grains as actually used in the preparation of the article. As a matter of fact, counsel for the defendant confused the issue and directed attention away from the real matter in controversy; the claims here submitted are *article* claims involving physical and not chemical characteristics of the elements entering into the combination, and it has been held again and again that under these circumstances definition by physical properties is proper. This contention is supported by the following decisions by Patent Office tribunals:

Ex Parte Kattwinkel, 12 U. S. Pat. Q. 11.

This case is decidedly in point in that it deals with an article (friction material for brakes or clutches) made up of elements and one of these elements is a resin. The Examiner in that case took exactly the same position as that expressed by counsel for the Patent Office at this Hearing, namely that claims "are broader than the invention, since only one type of synthetic resin has been disclosed". The Board of Appeals stated: "The applicant is dealing mainly with the *physical characteristic* rather than the chemical effect of the resin, and *we do not believe that this ground of rejection is properly applied to the claims in this case*". The Board refused to find that the disclosure of only one type of synthetic resin necessitated a limitation to claims to that specific resin since the physical properties of the resin were involved and not its chemical effect.

Ex Parte Kurtz, 15 U. S. Pat. Q. 149.

The rejection of the claims in this case was made on the ground that they were too broad. In considering this case the Board stated that broadly the process is old and the general steps shown to be old. But it pointed out that the cementing material used in the process is not the same as that of the references nor is there any teaching in the patents indicating equivalency. "Their equivalency may be apparent after appellant's teaching but their availability is in no way suggested by any cited art. Claims have been allowed which are limited to specific salts of copper and cobalt. As pointed out by appellant this is not consistent with the ground of rejection". The Board continues: "under the circumstances the protection granted ought not to be so restricted as to deprive appellant of the benefit of equivalents. As in mechanical cases where broad 'means' claims which go beyond the disclosure are frequently allowed which actually cover only fair equivalents of the means disclosed, so in chemical cases the use of broad terms need not unduly extend the monopoly".

Ex Parte Thomas W. W. Forrest (U. S. Patent Office Board of Appeals, 1930), 6 U. S. Pat. Q. 165.

The claimed invention related to treatment of "dried fruit" involving heating the same, then cooling, and applying an "edible oil" to the fruit during the cooling step. The applicant had named only "raisins" and "raisin seed oil" as the "dried fruit" and "edible oil", respectively. The Examiner contended that applicant's claims must, under the "doctrines" prevailing in the Patent Office, be restricted to those specific materials. But the Board of Appeals said:

> "The doctrine referred to, as above noted, is more especially applicable to chemical cases or to those cases where a true combination as distinguished from a mere mixture is involved. In cases such as the present, where the equivalency of substances embraced in the generic group can be foreseen with considerable certainty, a range of equivalency and latitude of definition more nearly approaching that permitted in mechanical cases appears proper."

Ex Parte August Schmidt, Jr. (U. S. Patent Office Board of Appeals, 1933) 21 U. S. Pat. Q. 176.

Appellant was inventor of a system of electrical distribution which was found to be generically novel. But the Examiner contended that the claims must be limited to the precise assemblage specifically disclosed. The Board of Appeals held:

> "In mechanical cases, generic claims are frequently predicated on a species disclosure. In the brief appellant has called attention to numerous decisions of this Board and the Courts, sanction-

> ing claims of this sort. To the cases cited we may add the decision of *Ryder, et al.*, v. *Townsend,* 188 F. 792, wherein the following statement appears: '* * * and when an inventor makes an invention and in his specifications points out a specific construction he may claim the specific construction and also have a general broad claim, and when this is done, in order to sustain the broader claim, it is not necessary for the patentee to point out in his patent that the specific construction shown is not essential to the invention. The law gives him ample protection whether he does or not.'
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> * * * * * * * *
>
> "It frequently happens in mechanical cases that generic claims are presented which embrace within their terms structures which are quite different than disclosed. Such claims may even embrace inoperative constructions. However, as above indicated, it has been the practice to allow such claims and leave their scope to be determined by the Courts in case of litigation. As a general proposition, no such claim affords protection except against others who accomplish substantially the same end by substantially the same means, the range of equivalents, of course, varying with the pioneer character of the invention."

Further to show the inconsistency of the position taken by defendant relative to what constitutes a proper definition of the invention as compared with the practice of the Patent Office, attention is called to claim 1 of the Carlton patent. Reference is made particularly to that patent as it indicates the practice followed in the particular division and by the particular examiners having charge of the present Redman application. That claim calls for a flexible sandpaper which includes a backing, a grit or layer of abrasive particles and a bond for uniting the grit to the backing; the bond is defined in the following words:

> "including a synthetic resinous condensation product which is solidified to a flexible and waterproof state".

Counsel for defendant in his brief submitted at the trial stated that the patents to Baekeland, Low, Crupi, Byck, Redman and Martin show the state of the art in connection with the manufacture of synthetic resin, varnishes, sandpaper, etc. These patents were all granted prior to the Carlton patent, and they must likewise show the state of the art with relation to that patent with regard to the manufacture of synthetic resin, varnishes, sandpaper, etc. Yet it is a fact that in claim 1 of the Carlton patent there is no distinction over such prior art other than the physical characteristic of the bonding agent (*i. e.*, "solidified to a flexible and waterproof state"). The only possible conclusion apparent is that it was this definition of the bond by its physical state that was relied upon by the Patent Office as distinguishing the patented claim from prior art references.

A further argument improperly injected was the limitation of the claims of the Redman application to one specific bonding agent as covered by allowed claims 8 and 9, on the ground that but one bonding agent is specifically described in the application. This is fallacious, because the present invention does not reside in the bonding agent itself but rather in a *new article of manufacture*, *i. e.*, a new sandpaper having the conjoint properties of flexibility and infusibility; in this article the bond is only one element entering into the combination. The bonding agent, it is true, is the essential element contributing to the sandpaper the new and useful properties which distinguish it from prior art sandpapers. But in a combination relying upon physical and not chemical characteristics of that agent, it is sufficient to describe one such agent that comes within the definition (Ex parte Kattwinkel, *supra*). There is the further fact that as a pioneer contribution entitled to a liberal construction, disclosure of one such agent is sufficient to warrant claims commensurate with the invention; it is not necessary or required that all equivalents be described in order to give the invention the protection to which it is entitled (*Morley* v. *Lancaster, supra*). The position taken in practice is that broad claims should be allowed to afford the necessary protection and their scope be determined if necessary in litigation (*Ex parte Kurtz, supra*).

The material question at this stage is a protection of Dr. Redman's invention that is commensurate therewith. To leave the inventor with but narrow claims insufficient to protect his invention and then rely on the benignancy of the Courts to broaden them, as suggested by Patent Office counsel at the trial, is not the answer. It is the duty of the Patent Office to cooperate to the extent that such a future course of action will not be necessary.

The allowed claims 8 and 9, referred to above, are inadequate to protect the invention for, among others, the reason that they limit the protection to an abrasive implement comprising a flexible base, abrasive grains, and a binder (for securing the grains to the base) including "a phenol-oil-resin reaction product". As the Redman application states, and as the expert witnesses testified at the trial, Dr. Redman's *basic contribution is the teaching that the abrasive grains may* *be secured to the flexible backing by means of any of the then known flexible synthetic resins.*

As was adduced by the expert witnesses, it was known—at the time Dr. Redman made his invention—that flexible infusible phenolic resins useful in coating compositions could be prepared by reacting phenol with an unsaturated body, broadly, and then reacting the resulting complex with a methylene-containing agent. If instead of "phenol-oil-resin reaction product" the allowed claims defined the bonding agent as, say,

> "a phenolic resin which when converted to the infusible state is inherently flexible",

the claims would adequately cover Dr. Redman's contribution to the art.

If appellant's patent protection is to be limited to an abrasive implement in which "phenol-oil-resin reaction product" is the bonding agent or adhesive for the abrasive grains, the granting of that patent would be a vain thing, since it would not enable appellant to exclude others from unauthorized enjoyment of direct fruits of this invention: appellant's competitors, being taught by that patent disclosure how to practice the real invention without technical infringement of its very restricted claims, freely could reap all its benefits.

CLAIM ADDED BY PRAYER OF BILL.

In addition to Claims A and B passed upon by the Board of Appeals of the Patent Office, the bill presents a third claim which was original claim 4 of the Redman application. In the Answer filed by the defendant, and at the trial below, reference was made to two such claims. There is in fact but one such claim, it having been repeated in prayer No. 1 that the Court adjudge the plaintiff to be entitled to such a claim and in prayer No. 4 that the Commissioner be directed to allow such a claim.

Original claim 4, recited in the prayers of the bill, reads as follows:

> "4. As a new article of manufacture, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a bond which is flexible at normal and higher temperatures but infusible at all temperatures, and non-tacky under all conditions of use."

As has been stated, this claim is original claim 4 in the Redman application. It incorporates both those limitations which had been stressed as features distinguishing claims A and B from the prior practice; that is, it recites a bonding agent which is *flexible* at normal and higher temperatures and *infusible* at all temperatures. In addition this claim includes a third limitation that the bond is non-tacky under all conditions of use.

Original claim 4 was considered three times by the Patent Office Examiner, and the art available was cited against it. This art, by the way, was the prior patents which have been set out in the answer to the bill and which have been briefly discussed hereinbefore. The claim, accordingly, has been given three independent considerations by the Patent Office, and three opportunities given to the Office for the citation of references. This Court has, therefore, the benefit of the reasoning and conclusions given by the Patent Office and the art upon which those conclusions are based.

The submission of new claims for the first time in a suit under R. S. 4915 has recently been the subject matter of the decision in the *Lucke* v. *Coe case*, 63 Appeals D. C. 61. That decision fully considers prior decisions relating to this submission of claims under R. S. 4915 and reviews them at considerable length.

It refers to the prior decision of *Durand* v. *Seymour* and interprets that decision. It is believed to be the latest pronouncement of the Court of Appeals made upon this matter and therefore may be accepted as the present view of this Court. In so far as it reviews prior decisions and modifies them it is reasonable to conclude that anything to the contrary in prior decisions is modified in these respects.

Nowhere in this latest decision is there any statement that claims urged in an action under R. S. 4915 must have been passed upon by the Board of Appeals. All that it indicates is that the Court should have the benefit of the consideration which the Patent Office might give on the claims submitted to it. The decision holds that the Court should have the benefit of the reasoning and conclusions of the Patent Office and it further holds that the Court is not intended to displace the Patent Office on newly submitted matter.

The claim presented in the prayer of the bill in this case conforms to the tests prescribed in the *Lucke* v. *Coe* decision. The claim has been considered by the Patent Office; in fact it has had three independent considerations. In the next place, it does not present—in its essential particulars—new matter differing from the subject matter of claims A and B which have been finally passed on by the Patent Office Examiner and the Board of Appeals. The essential limitations in this added claim are those of flexibility and infusibility; and these are the distinguishing limitations in claims

A and B submitted for consideration to the Examiner and to the Board of Appeals. If this added claim had been included with claims A and B in the appeal to the Board of Appeals it would have been subject to the same reasoning and the same ground of rejection; it would not have required any different action on the part of the Patent Office Examiner and the Board of Appeals from that which had been given to claims A and B. Accordingly, no inhibition is found in the *Lucke* v. *Coe* decision preventing consideration by this Court of the added claim.

The added claim is clearly patentable over the art of record. It incorporates the conjoint limitations of infusibility and flexibility, which are the distinguishing inventive features of claims A and B. In addition, it has the further limitation of a bond that is non-tacky under all conditions of use.

The claim, however, is desirable in that it is a broader expression of the invention than are claims A and B as to the non-inventive features and as to which features no reliance is placed for conferring patentability. From the standpoint of protection in the broader definition of the features not regarded as novel and not relied upon for patentability, the claim is believed necessary.

The present invention is an article of manufacture—not a chemical compound. Dr. Redman did not claim that any of his bonding agents were new, and in fact his (allowed) specific claims relate to the use, as bonding agent in this relation, of a material which, *per se*, was old. No invention being predicated upon the agents, *per se*, the Patent Office would only have been following its often-expressed practice, as delineated in the *Ex parte Kattwinkel* and *Ex parte Kurtz* cases above, in allowing the claims prayed for here.

CONCLUSION.

The issue presented by the claims set out in the bill is a new article of manufacture, namely a flexible abrasive implement combining the properties of flexibility with infusibility. The invention involved is of pioneer nature in that it is the first time that an abrasive paper *combining flexibility with infusibility* has been made available to the sandpaper industry. *This has been achieved by an entirely new approach to the problem, and as such is entitled to a liberal construction* and not to be limited to the specific preferred means whereby it has been accomplished. The claims prayed for are in proper form and they properly define the bonding element of the combination by its physical properties. The specification having set out one means of accomplishing the result and disclosed one species for its accomplishment, and having referred to the availability of equivalent means, generic claims are proper since it is not a chemical compound or composition which is involved but an article relying on physical characteristics.

The Carlton patent relied upon as an anticipation by the Patent Office does not disclose (1) an abrasive paper combining the physical properties of flexibility and infusibility, or (2) a paper with inherent flexibility or (3) operative means for accomplishing the alleged object; for these three reasons or any one of them it is not a valid anticipation. Nor is there anything in the additional patents mentioned in the answer having any bearing on the subject matter of the claims prayed for.

The claim which is included in the prayer does not come within the inhibition of the decision in the *Lucke* v. *Coe case*, and it presents for consideration the same distinguishing features of flexibility combined with infusibility in an abrasive paper which likewise distinguish claims A and B from the art of record.

It is respectfully submitted that at the trial below these critical differences between appellant's sandpaper and the sandpapers of the cited prior art were established by competent evidence. It is submitted that the Commissioner of Patents, at the trial below, failed to controvert the testimony adduced relative to

1. the inoperativeness of the Carlton disclosure;
2. the non-anticipatory value of a sandpaper using a "straight" phenol-aldehyde resin bond or using a plasticized resin bond; and
3. the availability, at the time Dr. Redman made this invention, of resins equivalents in this relation of the resin defined by the allowed claims and characterized by inherent flexibility coupled with infusibility.

It is submitted that the Commissioner of Patents has failed to appreciate the difference between article of manufacture claims and claims to a chemical compound, inasmuch as he has seemingly devoted his attention solely to the chemical identity of a single element of the article claimed by appellant rather than to the combination.

It is respectfully submitted, therefore, that the decree of the Court below should be reversed; that the prayers of appellant's Bill of Complaint should be granted; and that the Commissioner of Patents be authorized to issue to appellant a patent containing the claims recited in its Bill of Complaint.

Richard L. Scheffler,
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Charles H. Potter,
Ralph E. Parker,
Jos. N. Nielsen,
Of Counsel.

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

FILED NOV 12 1935

Henry W. Hodges

No. 6523

In the United States Court of Appeals for the District of Columbia

OCTOBER TERM, 1935

BAKELITE CORPORATION, APPELLANT
v.
CONWAY P. COE, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

R. F. WHITEHEAD,
Solicitor United States Patent Office.

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BRIEF FOR THE COMMISSIONER OF PATENTS

This is an appeal by the Bakelite Corporation from a decree of the Supreme Court of the District of Columbia dismissing plaintiff's bill. By that bill it was sought to have the Commissioner of Patents authorized to issue a patent upon an application filed by Lawrence V. Redman, Serial No. 214219, which was assigned to plaintiff.

The claims involved are claims numbered 10 and 11 and appear on page 62 of the Transcript of the Record.

The Redman application discloses a flexible sandpaper in sheet form, said sandpaper consisting of a flexible base with abrasive grains attached thereto by means of a resinous condensatious product of a phenolic body and an aldehyde. The sheet is inherently flexible and the bond is infusible.

The claims set out in paragraph 8 of the Bill are claims 10 and 11 of the application of Redman and read as follows:

> 10. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a condensation product of a phenolic body and an aldehyde characterized by flexibility inherent in the product per se when set by the action of heat to the infusible stage.
>
> 11. As a new article of manufacture, an abrasive implement comprising a flexible base, abrasive grains, and a binder for securing said grains to said base, said binder including a phenolic resin which when converted to the infusible stage is flexible in the absence of added plasticizer.

In the prayer of the Bill plaintiff prayed for the allowance of the following claim:

> As a new article of manufacture, an abrasive implement comprising a flexible base or carrier, and abrasive grains secured thereto by a bond which is flexible at normal and higher temperatures but infusible at

all temperatures, and nontacky under all conditions of use.

(This claim appears twice in the Bill, and inadvertently reference was made in paragraph 10 of the Answer to two claims.)

The prior art of record is as follows:

Low, 1243312, October 16, 1917.
Crupi, 1468960, September 25, 1923.
Byck, 1590079, June 22, 1926.
Redman, 1591999, July 13, 1926.
Martin, 1626246, April 26, 1927.
Carlton, 1775631, September 16, 1930.

The patent to Carlton, 1775631, describes fully a sandpaper consisting of a backing sheet, abrasive grains, and a bond. It also describes this bond as a phenol formaldehyde resin which contains a phenolic body and an aldehyde, and the characteristics of this body are fully set out, special attention being called to the statement in the patent as to the infusibility and flexibility of this bond. A process for producing the bond is also described.

The other patents, namely, Low, Crupi, Byck, Redman, and Martin, were cited to show to a limited extent the state of the art in connection with the manufacture of synthetic resins, varnishes, sandpaper, etc.

While the applicant in his application describes and claims an abrasive implement, the more usual form of which is what is commonly known as sandpaper, consisting of a backing, a flexible and infusible bond and grit, he does not claim to be the inventor of a process for making a flexible phenolic condensation product but states that he prefers to use the process described in the patent to Byck, 1590079 (R. p. 77, et seq.).

A complete description of an abrasive implement, that is sandpaper, having all the characteristics which applicant describes his product as having, the bond being a phenolic condensation product, is fully described in the Carolton patent. That being true, it is submitted that applicant could have had no inventive concept of a product such as set out in Claims 10 and 11. In other words, having read that patent, and he is chargeable with knowledge of it, there could have been no invention in the conception of a product such as set out in Claims 10 and 11.

In the recent decision of the Circuit Court of Appeals of the Second Circuit in *Buono et al.* v. *Yankee Maid Dress Corporation,* 77 F. (2d) 274, that Court, speaking through Judge Learned Hand, after stating that the patent in suit was for a product and was not limited to the process or machine by which the product was made, and stating that it conceivably might be possible to grant a patent limited to the process by which it is made, said:

> * * * That is probably not the law, though it is hard to find instances, probably because the Patent Office does not grant product patents in that form. At any rate a product patent not so limited—and the patent in suit is not—must be new as such, that

> is, regardless of the process or machine which makes it; and it must stand upon its own invention, again independently of the machine or process which makes it. (Citing decisions.) It would seem to follow that the invention in the case of such a product patent must lie exclusively in the conception of the product, and regardless of any method of its production, though, of course, the patent must disclose one way by which it can be made. While that imposes a severe standard, it is no severer than it should be, if the monopoly is to extend to the product however made. Unless conception alone is the test, and if the inventor may eke out his right by recourse to the ingenuity involved in any process or the machine, he gains an unfair advantage; for the claims cover the product produced by other machines and processes, to which, by hypothesis, he has contributed nothing.

Evidence was offered which is alleged to show that the process described in the Carlton patent will not make an infusible flexible condensation product. It is submitted, however, that that fact is immaterial, since in view of the description of the product there is no inventive concept in Claims 10 and 11, which are not limited to any particular phenolic condensation product, but only to such a product which is characterized by flexibility inherent in the product under certain conditions.

Applicant claimed to have made a discovery, namely, that he could use the product of the Byck patent as a bond for a sandpaper and that, it is submitted, is all the invention he has made, and claims for that invention have been allowed.

That discovery is no ground, however, for allowing this applicant claims which when the patent is granted would give him a monopoly of 17 years for the use, as a bond for sandpaper, of any and every phenolic condensation product having the characteristics stated in Claims 10 and 11.

So far as the question of inoperativeness of the Carlton disclosure is concerned, that question is ruled by the decision of this Court in *In re Decker,* 36 App. D. C. 104, 1911 C. D. 274, in which it was specifically held that where in prior patents there was described a bilged barrel-body made of paper-pulp, a later inventor could not obtain a patent on that product even though the patents which disclosed the product described inoperative processes and apparatuses and so far as was known there was no other process by which this body could be made.

In that case, after citing the decision of the Supreme Court of the United States in *Cohn* v. *U. S. Corset Co.,* 93 U. S. 366, 1877 C. D. 205, the Court said:

> In the present case, appellant is not claiming a process for making a barrel—he has a patent for that—but he is here seeking a patent on the product, the barrel itself. We think it sufficient that the product was clearly described in the Taylor and the Clark

> patents. The inoperativeness of these patents might be material if we were considering process claims. But that is not this case.

Looking at the case from another aspect, the situation is closely analogous to the well-known theory of the issuance of chemical patents, that is, that the disclosure in an application that one of a long chemical series is useful for a certain purpose, will not entitle the applicant to claim the use of the entire series. The underlying theory of this is that the disclosure of the properties of one of the series does not necessarily show that all of the other members of that series have the same properties.

Such a situation was before this Court *In re Dosselman and Neymann,* 37 App. D. C. 211, 1911 C. D. 379. There it was ruled that the fact that an applicant had discovered that acetone was useful as an element in a paint remover and had described in his specification no other members of the ketone series as being useful for this purpose, did not entitle him to a claim for a composition including a "ketonic finish-softening material." The decision was rendered at the same time as the one in *In re Ellis,* 37 App. D. C. 203, 1911 C. D. 374, in which the whole theory above referred to is very fully discussed.

It is submitted that none of the decisions cited in applicant's brief are in point as to his right to these broad claims. They were each based upon a state of facts entirely different from the state of facts here presented.

With respect to the claim which appears in the prayer of the Bill, it is to be noted that this claim, as the record shows, was presented by the applicant, rejected by the Examiner, argued, and finally cancelled. It was not included in the appeal to the Board of Appeals and was not passed upon by that tribunal.

It is submitted, therefore, that under the ruling of this Court in the case of *Lucke* v. *Commissioner of Patents,* 63 App. D. C. 61, 1934 C. D. 44, that claim is not before this Court for consideration.

Applicant appears to draw a distinction between the Lucke case and the facts of this case in that in the former the claims were presented for the first time before the Supreme Court of the District of Columbia whereas here the suggested claim was considered by the Examiner. It is submitted that this distinction is immaterial. Certainly an applicant is not entitled to present to the Supreme Court of the District of Columbia and this Court and have them pass upon the patentability of a claim which he deliberately did not submit to the appellate tribunal of the Patent Office, namely the Board of Appeals.

It has been repeatedly said by the courts that a suit under Section 4915 R. S. (35 U. S. C. A. 63, as amended) is in the nature of a suit to upset a decree. The decree referred to is the determination by the Patent Office. In other words, it is the decision of the Board of Appeals. Applicant's case, therefore, must necessarily be limited to the case he made before the appellate tribunal of the Patent Office and as to which he obtained a decision.

However, if this claim could possibly be considered to be properly before this Court, it is submitted that everything that has been said herein as to patentability as to Claims 10 and 11 applies with greater force to the proposed claim. Claims 10 and 11 are at least limited to a phenolic condensation product. The proposed claim is not, since it specifies merely a bond which is "flexible at normal and higher temperatures but infusible at all temperatures, and nontacky under all conditions of use." The allowance of such a claim would give to applicant and his assignee a monopoly in the making of sandpaper by the use of a bond having the characteristics stated no matter by whom such a bond is hereafter discovered or when. Applicant has made no such contribution to the art as would entitle him to an allowance of any such broad claim.

It is submitted that the consideration of the claim appearing in the prayer of the Bill should be refused and that the decree of the Supreme Court of the District of Columbia dismissing the Bill should be affirmed.

R. F. Whitehead,
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Attorney for Appellee.

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